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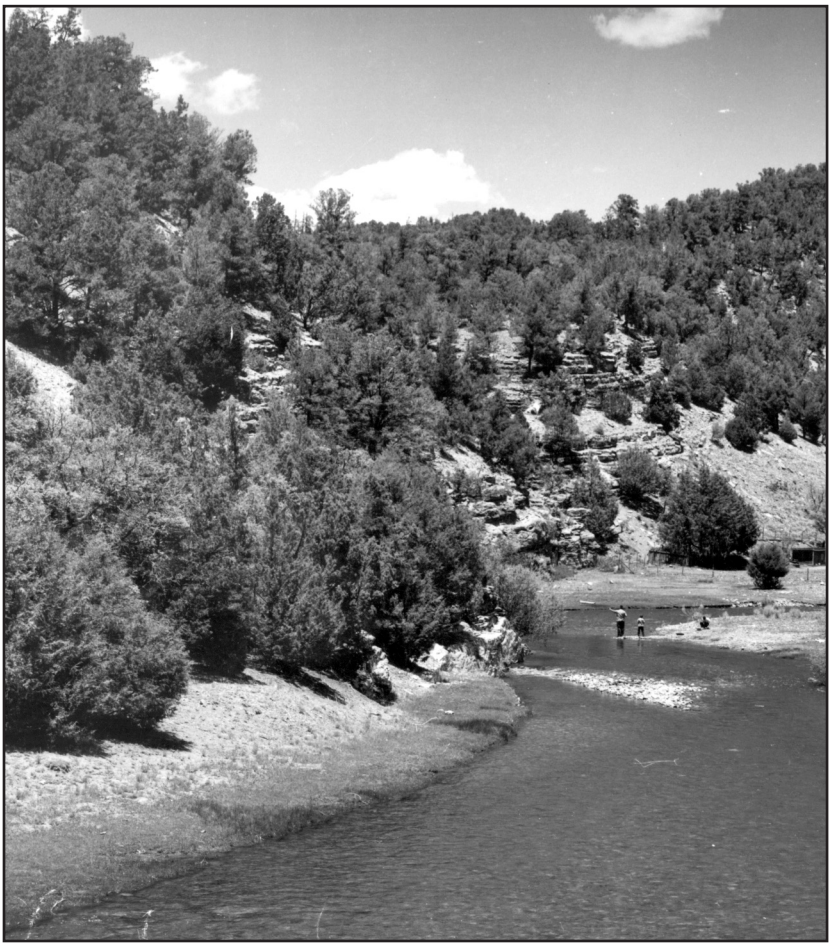
Plant Associations of Arizona and New Mexico

Volume 2: Woodlands



Plant Associations of

Arizona and New Mexico Volume 2: Woodlands

An Update of the
USDA Forest Service
Southwestern Region
Habitat Typing Guides

September 1996
Revised July 1997

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Acknowledgements

This report represents the product of the work of many people over many years to develop and improve a vegetation classification system for the forests and woodlands of Arizona and New Mexico.

This version has been compiled, written, and edited by Mary Stuever and John Hayden. It is primarily based on three regional guidebooks compiled in the mid 1980's by editors/authors Will Moir and Milo Larson, with assistance from Dick Bassett, Reggie Fletcher, Esteban Muldavin, Suraj Ahuja, and Maurice Williams.

Research to describe habitat types in Arizona and New Mexico was conducted by Billy G. Alexander, Jr., Fairley J. Barnes, Robert L. DeVelice, E. Lee Fitzhugh, Richard E. Francis, Jess P. Hanks, Sharon R. Hanks, Kathryn Kennedy, Earl F. Layser, John A. Ludwig, Will Moir, Esteban Muldavin, Frank Ronco, Jr., Gilbert H. Schubert and Alan S. White. In addition, plant association descriptions from numerous authors have been adapted to develop the woodland descriptions.

Information for this update has come from many sources including comments from reviewers, who are primarily natural resource professionals who utilize habitat typing information, information from the Fire Effects Information System, a database maintained by the U.S. Forest Service's Intermountain Fire Sciences Laboratory in Missoula, Montana, a large body of literature on fire history generated by researchers associated with the University of Arizona's Laboratory of Tree Ring Research in Tucson, Arizona, and numerous other research publications.

Comments on these updated plant association descriptions were provided by: Norm Ambos, Jack Carpenter, Francisco Escobedo, Will Moir, Don Moniak, Wayne Robbie, Gregg Sant, John Shafer, and Rita Suminski.

Comments on the regional key were provided by: Norm Ambos, Kim Paul, John Shafer, and Charlie Wicklund.

Thanks also to the 1997 Habitat Typing Workshop participants who provided additional field review.

Preface

Over 10 years ago I had the opportunity to attend a 4-day, field-based workshop on habitat typing. The course, one of eight presented in the mid-1980's by Will Moir and Milo Larson, was one of the most significant experiences of my forestry career. I found that by utilizing the habitat typing or plant association concepts, I could finally communicate with my peers about forest ecology observations and rapidly increase my understanding of a wide diversity of forest ecosystems. By providing a language for the transmission of ideas and observations, habitat typing (referring to forest stands by their plant associations) has greatly enhanced our ability to discuss and understand the role of forest management in a wide variety of types.

Although foresters (particularly silviculturists) originally pioneered the use of habitat types in this region, this tool is now employed by many other natural resource professionals, including range conservationists, wildlife biologists, engineers, soil scientists, landscape architects, etc. Every year more natural resource professionals realize the value of using this classification system to provide site specific guidelines based on past experiences in similar areas for predicting future responses to management activities.

The nature of this system is dynamic. As more experience is assembled by many professionals and researchers working in the field, our overall understanding of each plant association increases. When Will Moir presented me with my set of the regional habitat typing guides in 1987, he assured me that this was just the beginning. Yet, I was told, as a working professional in the field, it would be my responsibility, as well as the rest of my colleagues, to collect the information we gleaned from our experiences and enhance these guides.

I have kept this directive in mind, as I have facilitated a dozen habitat typing courses. I have been mentored by hundreds of resource professionals who have been involved in these workshops.

I am grateful to have the daunting, yet exciting opportunity to update the plant association descriptions for the Southwestern Region's forests and woodlands. Our goal has been to enhance the previous edition of the habitat typing guides by expanding information and establishing language for multi-disciplinary use, and yet maintain the information that was already provided.

This publication can be considered as edition 3 of our knowledge of plant associations. Edition 2 was the three volume set of Forest and Woodland Habitat Types for three geographic regions within the Southwest compiled by Moir & Larson. Edition 1 was the handouts provided during the first round of habitat typing training in this region (taught by Moir & Larson). I would like to pass along the challenge to all users of this guide to continue to document your observations and experiences for Edition 4. Comments on this guide should be sent to the Regional Forester, USFS Southwestern Region, 333 Broadway Blvd., SE, Albuquerque, New Mexico 87102.

This field guide could not have been assembled in the timeframe needed without the assistance of John Hayden. I am indebted to John for his tireless commitment to this project even though the work exceeded all of our estimates of what would be required.

I would also like to commend Forest Service Regional Silviculturist John Shafer for his commitment and vision to see this project through, and his excellent insight, knowledge, and understanding of the southwestern forest habitat types.

The real credit for the existence of the plant association classification system in the Southwest goes to the hundreds of resource professionals that use this system to communicate their extensive knowledge of our natural resources. Hopefully, you will find this volume a useful resource to your daily operations.

Mary Stuever
Consulting Forester
Placitas, New Mexico
September 30, 1996

Introduction

Forests and woodlands are naturally complex and diverse ecosystems and, therefore, difficult to thoroughly understand or predict changes which may result from management activities or inactivities. Classification of various types of forests and woodlands allows us to make general statements about observations in one site and apply the knowledge learned to a similar site. The recognition of plant associations provides one system of classification, based on potential natural vegetation, and applied at the plant association level.

This publication describes the known plant associations for forests and woodlands in Arizona and New Mexico. Many sources were utilized to compile these descriptions, but the primary sources for this edition are three regional habitat typing guides developed by the Forest Service in 1986 and 1987.

This book is divided into three parts. The introductory material will provide background information on interpreting the descriptions, recent nomenclature changes for plants, and a key to the plant associations. The second and largest section is the descriptions for each plant association. The appendices include a bibliography, a synonymy list of plant name changes, and a list of plants mentioned in the descriptions.

Plant associations, or habitat types, have been used for classification throughout the west. The concept was first developed in western Washington by R. F. Daubenmire. Habitat types for Arizona and New Mexico were described by many researchers, primarily in the late 1970's and through the mid 1980's. Plant associations are still being recognized and described today, and conceivably there will be stands that will not fit any of the descriptions in this guidebook.

Although this classification system of plant association descriptions is based on climax or very late successional stand conditions, frequently the stands being classified are often in early or mid successional stages. Additionally one should recognize that there are often many climax conditions for a plant association which are influenced by the stand's history. The fire exclusion disclimax that many of the plant associations are based on, may not be the desired future condition the manager is hoping to attain through prescribed activities. It is helpful to think of the plant association as a "name" rather than a goal for stand conditions.

Another important guideline when matching these descriptions to stands in the woods is to expect variation. The descriptions are based on the "typic" expression of the associations, although "ecotones" between associations are frequently encountered in the field. Descriptions also cover broad geographic areas, and usually not all the plants listed will actually occur in any given stand.

Information may not be consistent from association to association. Therefore, stating that one association has high aesthetic value does not imply that others do not. Rather it implies that literature or comments on aesthetic value were not available for associations that omit this information.

NOTES ABOUT PLANT NAMES

Since the publishing of the three Regional Forest and Woodland Habitat Type (Plant Association) guides in 1986 and 1987, approximately 25% of the scientific names of the plants have changed. An effort to update the nomenclature while at the same time provide the older, outdated names was made and is listed in the Synonymy section.

The PLANTS database was used for genus and species names and codes. It is maintained by the USDA Natural Resources Conservation Service and presently considered the appropriate authority recording and abbreviating scientific and common plant names. However the following exceptions were made:

- The scientific name for corkbark fir in the existing version of the PLANTS database is *Abies lasiocarpa*. However, the currently correct name which is accepted by most is *Abies bifolia*.
- Although the PLANTS database tends to follow conventions more common in naming animals by giving a possessive voice to a proper name, it was decided to follow normal botanical conventions and omit the possessive voice, so "Gambel's oak" would become "Gambel oak".
- The spelling and punctuation for the common and scientific names from the database was used with one exception. The hyphen for Douglas-fir was included. The spelling of scientific names also varies, where *Pachystima* is spelled throughout the Region, it is referenced in the database as *Paxistima*.
- Although *Pinus fallax* is not in the PLANTS Database, it was decided to continue the use of this name for the single-needled pinyon that occurs in central Arizona. The common name is Arizona pinyon.

SOME ESSENTIAL TERMS AND CONCEPTS

Scarce - less than 1% cover, versus common - greater than 1% cover.

Poorly represented - less than 5% cover, versus well-represented - greater than 5% cover.

Abundant - greater than 25% cover.

Luxuriant - greater than 50% cover.

Absent - can not be found in the stand, versus present - can be found in the stand.

Accidental - individuals infrequent, occasional, or limited to special microsites.

Dominant - Density or cover is as great as, or greater than, any other species of the same life form (two or more species can be dominant, i.e. codominant).

Regeneration - understory trees as established seedlings, saplings, or small poles (DBH <10 inches).

OTHER RELATED DOCUMENTS

Plant Associations of Arizona and New Mexico, Volume 1: Forests.

Terrestrial Ecosystem Survey Mapping Units/Plant Association Crosswalk (in preparation).

Format Notes for Plant Association Descriptions

Explanations of each of the subheadings found in the plant association descriptions follow.

PLANT ASSOCIATION IDENTIFICATION

Names for each plant association are found at the beginning of each description. Each association is usually named for the most shade tolerant tree successfully regenerating, and for an understory species (shrub or herb) which is most diagnostic of the site. The common name of the plant association appears first, followed by an abbreviated code. Plants that occur in the US are assigned this code by the Natural Resources Conservation Service Plants Database. The code is usually the first two letters of the genus and the first two letters of the species. An additional letter may be added to clarify a variety or subspecies. Where different species have the same codes, numbers are assigned to provide a unique abbreviation for each species. The scientific name for the plant association is also given. If the plant association was known by a different name in the regional guides mentioned above, this name is also included in the heading as "formerly ....".

Often when plant associations, habitat types, or community types are referred to in publications, the name of the plant community is followed by an abbreviation to indicate the type. We have only included these initials if the plant community is <u>not</u> a habitat type or plant association. For example, PIPO/ARPU c.t. refers to the ponderosa pine/Manzanita community type.

The vegetation code is used by the U.S. Forest Service and other agencies and organizations for data storage. The first digit recognizes the form, the next two digits delineate the series, the following two digits are for the specific plant association (habitat type), and the last digit, if present, is a phase designator. For example the code for ponderosa pine/Arizona fescue, Gambel oak phase is 0 11 09 3. The first '0' designates a forest, the '11' ponderosa pine, the '09' identifies the association, and the '3' is the phase indicator.

If the plant association has been labeled by other researchers using different species to name the type, these alternate names have been included in the synonym field, along with a reference to the publication in which these alternate names appear.

KEY CRITERIA

The key criteria section is a brief snapshot description of the plant association highlighting features that separate it from similar plant associations. This usually includes a discussion of the overstory—as well as what is absent from the overstory, and may also provide limited geographical information.

STAND STRUCTURE AND PRODUCTIVITY

This discussion includes information on tree site indices, forage rating values, and other structure and productivity information when available. In general, tree site index information is sketchy and not very reliable. There is probably a wide variance in site indices within most associations.

Often a stockability factor is given. Stockability is an estimate of the stocking potential of a given site; a fully stocked site has factor of 1.0. For example, a factor of 0.5 indicates that the site is capable of supporting only 50 percent of timber species of "normal" stocking as indicated in yield tables. The stockability factors are subjectively assigned to each association, and not necessarily determined from extensive data.

LOCATION

This section gives geographical information on several scales, but specific to Arizona and New Mexico. General ranges, often including place names, are provided, as well as specific site information such as elevation, slope, aspect and/or soil characteristics. Elevations are given in feet and meters, and are determined from research data. Expect these elevational ranges to be narrower than what may actually be encountered throughout the region. Where determined, precipitation and soil temperature data are also included.

ADJACENT HABITAT TYPES

Landscape patterns of plant associations are discussed here.

ALSO SEE

This section provides suggested references to check to help clarify this plant association identification, or if the description isn't quite right, to find a better description.

TREES & LIFE HISTORY TRAITS

When this document is prepared for publication, this information should ultimately be presented in a chart. For each phase or geographic region, trees are listed by common name (scientific name) and a letter code indicating the general role that species assumes in the plant association. Capital C stands for major climax, a species which is clearly regenerating successfully and surviving to maturity in late and advanced stages of succession. The species is also present in all (or nearly all) stands. Capital S stands for major seral tree, a species which is clearly regenerating successfully and surviving to maturity only in early and mid stages of succession, although mature trees often persist as overstory in later stages. The species is also present or potential in all (or nearly all) stands. Small c stands for minor climax, and include species that meet the major climax definition, except they may not be present in all stands. Small s stands for minor seral and includes species that meet the major seral definition, except the species may not occur (now or as potential) in all (or most) stands. Trees that are accidental are referred to in the "Key Criteria" section. Trees not listed or mentioned do not occur in the association.

SHRUBS AND HERBS PLANT LIST

Shrubs and herbs are listed in separate categories. For each category, the typical canopy coverage is given using defined terminology such as common (>1%), scarce (<1%), well (>5%) or poorly (<5%) represented, abundant (>25%), and luxuriant (>50%). Species that are diagnostic to the association are highlighted and indicated with an asterisk (*). Species are ordered according to overall importance throughout the range of

the plant association, but the occurrence of individual species will vary geographically. Usually, individual stands will **not** include all the species in an association species list.

CRYPTOGAMS

This section includes notes on mosses and lichens which have been associated with the plant association. If none are listed, this may mean we have no information on cryptogams for that plant association, rather than implying that there are no cryptogams in the association.

BRIEF PLANT ID NOTES

The brief plant identification notes are intended to serve as reminders to key characteristics of indicator plants, and not to be used as a single source for plant identification. A synonymy list includes any recent scientific names and a few other common names for plants mentioned in the description.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Three values indicating the typical TES climate class are given. The first value is the life zone class. These codes are:

4 (woodlands)
5 (ponderosa pine forest)
6 (mixed conifer forest)
7 (subalpine forest)

The second value indicates a temperature and moisture phase within each life zone class. These codes are: -1 = warm, dry; 0 = typical or modal; +1 = cool, wet.

The third code indicates the climate class which consists of two parts. The first two words refer to the season in which the majority of the precipitation on the site occurs. High sun refers to a summer precipitation dominated site, and low sun refers to the bulk of the precipitation coming in the winter months. The second part of the climate class is either mild or cold. Therefore, the four possible climate class codes are Low Sun Cold (LSC), Low Sun Mild (LSM), High Sun Cold (HSC), and High Sun Mild (HSM).

PHASES

This section includes information on variations between phases and any specific comments related to a phase.

FIRE ECOLOGY

Fire ecology information may include known fire regime information such as fire return intervals, severity, etc., or specific plant responses to fire. When possible, we have tried to distinguish between presettlement and current fire conditions. We have tried to include information on fire behavior specific to the habitat type, observations on successional trends following fire, and information on the use of and responses to prescribed fire.

REFORESTATION

This section includes information on natural regeneration, artificial regeneration, and timber harvesting activities. The focus of this discussion is on the regeneration of timber species.

REVEGETATION

This discussion refers to site responses following disturbances of any site component, but focuses on early seral species.

COMMENTS

This discussion may include specific wildlife, recreation, or range comments, potential opportunities for firewood or other resource products, ecological observations on successional pathways not already mentioned, insect or disease concerns associated with a plant association, or any other comments.

One value commonly included in this section is Budworm Susceptibility. This is an index value for site climate used in determining a Budworm Susceptibility Rating. The rating is assigned to stands and used to prioritize stand treatments. In addition to site climate index value, the rating also considers species composition, stand density, height class structure, vigor, maturity, regional climate, and surrounding host type. This rating system is currently being revised and these values may be obsolete in the new system.

REFERENCE(S)

The author and date of documents used to develop the description of this plant association are listed here. For full citations, refer to the bibliography.

Keys to Plant Associations of Southwestern Forests and Woodlands

These keys have been developed to help identify plant associations for forests and woodlands for the Southwestern Region (Arizona and New Mexico). These keys (and the accompanying plant association descriptions) do not cover non-forested environments, including alpine tundra, chaparral, shrublands, grasslands, meadows, etc. In addition, this key does not provide information on mountainous riparian areas at the plant association level, although some series are addressed, nor are lower elevation forests along rivers (i.e. bosque) included. This key primarily has been derived from 3 keys (USFS 1987a, 1987b, 1986) that cover 3 geographic regions of this area.

USING THE KEYS

These keys work best in stands where disturbances have been minimal. Stands in early to mid-seral stages of succession generally will not key directly to their association. In young or recently disturbed stands, the association must be inferred from site factors, indicator species, tree successional relationships or from known successional stages. Fortunately later successional (near climax) conditions can usually be inferred from the most shade tolerant tree species that is successfully reproducing. When trying to key any early seral stand, look for patterns on the local landscape. Find the most mature stand on a similar site in the local landscape and apply the keys to that stand.

To use the key, determine the combination of potential climax tree species by noting especially the proportions of trees in young, regenerating sizes. This helps determine the series, which is generally based on the most shade tolerant species regenerating in the stand. **Always start in the first key, the Series Key to Forests and Woodlands.** There are exceptions to every rule which guides this classification system, and only by using the keys can the proper series be determined. Keys A through J are the keys for each series or group of similar series. In these keys, it is necessary to identify certain understory shrubs and herbs (indicator species) and to note their canopy coverage. Coverage classes are defined in the terms below.

Proceed through the key making careful observations required at each decision couplet. When the decision of which part of the couplet to follow is difficult, try both options. Validate the determination against the plant association description which best fits your observations. Check your observations if descriptions do not agree. No stand will fit the description perfectly.

ESSENTIAL TERMS

Scarce - less than 1% cover, versus common - greater than 1% cover.
Poorly represented - less than 5% cover, versus well represented - greater than 5% cover.
Abundant - greater than 25% cover.
Luxuriant - greater than 50% cover.
Absent - cannot be found in the stand, versus present - can be found in the stand.
Accidental - individuals infrequent, occasional, or limited to special microsites.
Dominant - Density or cover is as great as, or greater than, any other species of the same lifeform (two or more species can be dominant, i.e. codominant).
Regeneration - understory trees as established seedlings, saplings, or small poles (DBH <10 inches).

FOR YOUR INFORMATION

Some of the terminology and many of the plant names have changed since the regional keys were published in the mid-1980's. Here is a short list of some of those changes you may encounter in these keys (See Appendix A for a long list).

Terms

"Plant Association" = "Habitat Type"

The scientific name for:	**has changed from:**	**to:**
wavyleaf oak	*Quercus undulata*	*Quercus* X*pauciloba*
black sagebrush	*A. arbuscula* var. *nova*	*Artemisia nova*
cliffrose	*Cowania mexicana*	*Purshia stansburyiana*
Arizona peavine	*Lathyrus arizonica*	*L. lanszwertii* var. *arizonica*
Dore spear grass	*Stipa columbiana*	*Stipa nelsonii* spp. *dorei*

The common name for:	**was last published as:**	**is standardized to:**
Artemisia nova	low sagebrush	black sagebrush
Jamesia americana	waxflower	cliffbush
Carex foenea	fony sedge	dryspike sedge
Senecio cardamine	Cardamine groundsel	bittercress ragwort
Stipa nelsonii spp. *dorei*	western needlegrass	Dore spear grass

SERIES KEY TO FORESTS AND WOODLANDS

1. Streamside environments with riparian obligate trees such as cottonwood *(Populus fremontii, P. deltoides,* or *P. angustifolia),* alder *(Alnus tenuifolia* or *A. oblongifolia),* willow *(Salix* spp.), sycamore *(Platanus wrightii),* or boxelder *(Acer negundo).* (Note: Arizona walnut *(Juglans major)* does not qualify as a riparian obligate tree since it also occurs in dry or intermittent drainages)...**Key G, Riparian Forests**, page 18.
1. Other environments without riparian obligate plants....2

2. Dominant (density or cover is as great as, or greater than, any other species of the same lifeform) trees species regenerating include corkbark fir *(Abies bifolia)*, Engelmann spruce *(Picea engelmannii)*, bristlecone pine *(Pinus aristata)*, blue spruce *(Picea pungens)*, white fir *(Abies concolor)*, limber pine *(Pinus flexilis)*, Douglas-fir *(Pseudotsuga menziesii)*, ponderosa pine *(Pinus ponderosa)*, Apache pine *(Pinus engelmannii)*, or Chihuahua pine *(Pinus leiophylla)*....3
2. Dominant trees species regenerating include species of pinyon pine *(Pinus edulis, P. discolor,* or *P. fallax),* juniper *(Juniperus monosperma, J. deppeana, J. osteosperma,* or *J. erythrocarpa),* Arizona cypress *(Cupressus arizonica)*, or oak *(Quercus grisea, Q. oblongifolia, Q. emoryii, Q. hypoleucoides,* or*Q. arizonica)*....9

3. Forests of talus or debris slopes with fragmental soils (cobbles or stones >90% of soil volume)....**Scree Forests**, Volume 1, page 255.
3. Forests of other environments....4

4. Corkbark fir *(Abies bifolia)* and/or Engelmann spruce *(Picea engelmannii)* and/or bristlecone pine *(Pinus aristata)* is dominant or reproducing successfully, clearly not accidental....**Key A: Engelmann Spruce, Corkbark Fir & Bristlecone Pine Series**, page 10**.**
4. Corkbark fir *(Abies bifolia)* and/or Engelmann spruce *(Picea engelmannii)* and/or bristlecone pine *(Pinus aristata)* is absent or accidental (or present in seral stages only)....5

5. Blue spruce *(Picea pungens),* white fir *(Abies concolor),* limber pine *(Pinus flexilis),* or Douglas-fir *(Pseudotsuga menziesii)* dominant or reproducing successfully, clearly not accidental....6
5. Blue spruce *(Picea pungens),* white fir *(Abies concolor),* limber pine *(Pinus flexilis),* or Douglas-fir *(Pseudotsuga menziesii)* absent or accidental....8

6. Blue spruce is common, clearly not accidental...**Key B: Blue Spruce Series**, page 13.
6. Blue spruce is absent or accidental....7

7. White fir is dominant or reproducing successfully, clearly not accidental.... **Key C: White Fir Series**, page 13**.**
7. White fir is absent or accidental....**Key D: Douglas Fir & Limber Pine Series**, page 15.

8. Ponderosa pine dominant without presence of additional Madrean pines.... **Key E: Ponderosa Pine Series**, page 16.
8. Madrean pines including Apache pine *(Pinus engelmannii),* Chihuahuan pine *(Pinus leiophylla),* and Arizona pine *(Pinus arizonica)* are common, clearly not accidental, location SE Arizona or SW New Mexico...**Key F: Apache Pine and Chihuahuan Pine Series**, page 17.

9. Arizona cypress *(Cupressus arizonica)* present, not accidental...13
9. Arizona cypress *(Cupressus arizonica)* absent or accidental 10

10. Woodlands of slopes >40% and rocky or bouldery soils with much rock outcrop or bare rock soils...**Scarp Woodland,** page 159.
10. Woodlands of slopes <40% or soils not as described above...11

11. Evergreen oaks *(Quercus grisea, Q. oblongifolia, Q. emoryii, Q. hypoleucoides,* or. *arizonica)* are well represented (>5% cover) to abundant (>25% cover) in the tallest stratum, geographic locations in southern Arizona or southern New Mexico....**Key H: Madrean Oak Woodlands**, page 18.
11. Evergreen oaks are poorly-represented in the tallest stratum....12

12. Pinyon pine *(Pinus edulis, P. discolor,* or *P. fallax)* is dominant or reproducing successfully, clearly not accidental ....**Key I: Pinyon Pine Series**, page 19.
12. Pinyon pine *(Pinus edulis, P. discolor,* or *P. fallax)* is absent or accidental, juniper *(Juniperus monosperma, J. deppeana, J. osteosperma,* or. *erythrocarpa)* is dominant and reproducing successfully.....**Key J: Juniper Woodlands**, page 23.

13. Silverleaf oak *(Quercus hypoleucoides)* common .....**CUAR/QUHY**, Vol. 2, page 25.
13. Silverleaf oak *(Quercus hypoleucoides)* absent or accidental .....**CUAR/QUTU2**, Vol. 2, page 27.

KEY A: ENGELMANN SPRUCE, CORKBARK FIR & BRISTLECONE PINE SERIES

(All page numbers refer to Volume 1: Forests)

1. Bristlecone pine *(Pinus aristata)* is dominant at climax (northern NM or northern AZ)....2
1. Bristlecone pine *(Pinus aristata)* is absent or not dominant at climax....4

2. Currants *(Ribes)* common, grasses poorly represented..**PIAR/RIMO2**, page 81.
2. Currants *(Ribes)* scarce, grasses usually well represented...3

3. Thurber fescue *(Festuca thurberi)* common....**PIAR/FETH**, page 79.
3. Thurber fescue *(Festuca thurberi)* absent or scarce....**PIAR/FEAR2**, page 77.

4. Herbs and shrubs are scarce.....5
4. Herbs and shrubs are at least common.....6

5. Corkbark fir *(Abies bifolia)* is codominant, reproducing successfully.... **ABBI/moss**, page 65.
5. Corkbark fir *(Abies bifolia)* is absent, or not reproducing successfully... **PIEN/moss**, page 51.

6. Saturated soils.....**ABBI/MECI3**, page 63.
6. Soils otherwise.....7

7. Beardless wildrye *(Leymus triticoides)* is common (Capitan Mtns, southern NM).....**PIEN/LETR5**, page 33.
7. Beardless wildrye *(Leymus triticoides)* is scarce or absent, or geographic location is other.....8

8. Regeneration of corkbark fir *(Abies bifolia)* is absent, accidental, or minor....9
8. Regeneration of corkbark fir *(Abies bifolia)* is present, clearly not accidental or minor.....17

9. Nearly pure stands of Engelmann spruce *(Picea engelmannii)* (bristlecone pine *(Pinus aristata)* may be present)....10
9. Engelmann spruce *(Picea engelmannii)* in association other mixed conifer trees such as blue spruce *(Picea pungens)*, white fir *(Abies concolor)*, or Douglas-fir*(Pseudotsuga menzensii)*; but corkbark fir *(Abies bifolia)* is minor, if present.....12

10. Whortleberry *(Vaccinium myrtillus)* is present, often well presented; skunkleaf polemonium *(Polemonium pulcherrimum* ssp. *delicatum)* is also present ..... **PIEN/VAMY2-POPUD3, PIEN phase**, page 47.
10. Whortleberry *(Vaccinium myrtillus)* is absent; skunkleaf polemonium *(Polemonium pulcherrimum* ssp. *delicatum)* may be present or absent.....11

11. Ross avens *(Geum rossii)* dominates herbaceous understory; shrubs are scarce [San Francisco Peaks, AZ].....**PIEN/GERO2**, page 31.
11. Gooseberry currant *(Ribes montigenum)* is common, herbs are scarce..... **PIEN/RIMO2**, page 39.

12. Understory essentially shrubby; herbs may be well represented.....13
12. Understory essentially herbaceous; shrubs may be well represented....15

13. Whortleberry *(Vaccinium myrtillus)* is well represented....**PIEN/VAMY2**, page 45.
13. Whortleberry *(Vaccinium myrtillus)* is poorly represented.....14

14. Kinnikinnick *(Arctostaphylos uva-ursi)* is common.....**PIFL/ARUV**, page 159.
14. Kinnikinnick *(Arctostaphylos uva-ursi)* is scarce or absent.....**PIEN/ACGL**, page 25.

15. Bittercress ragwort *(Senecio cardamine)* is common.....**PIEN/SECA6, ABCO phase**, page 41.
15. Bittercress ragwort *(Senecio cardamine)* is scarce or absent.....16

16. Engelmann spruce *(Picea engelmannii)* is dominant; blue spruce *(Picea pungens)* is minor or absent....**PIEN/EREX4**, page 27.
16. Blue spruce *(Picea pungens)* is dominant, Engelmann spruce *(Picea engelmannii)* is minor....**PIPU/EREX4**, page 95.

17. Whortleberry *(Vaccinium myrtillus)* is common to well represented, clearly a dominant species in the understory....18
17. Whortleberry *(Vaccinium myrtillus)* is absent, or if present, is not a dominant understory species....20

18. Skunkleaf polemonium *(Polemonium pulcherrimum* ssp. *delicatum)* is common.....**PIEN/VAMY2-POPUD3, ABBI phase**, page 47.
18. Skunkleaf polemonium *(Polemonium pulcherrimum* ssp. *delicatum)* is scarce or absent.....19

19. Corkbark fir *(Abies bifolia)* is dominant in regeneration; white fir *(Abies concolor)* is minor or absent.... **ABBI/VAMY2**, page 73.
19. Corkbark fir *(Abies bifolia)* is minor; white fir *(Abies concolor)* regeneration is dominant.....**ABCO/VAMY2**, page 155.

20. Blue spruce *(Picea pungens)* is common, reproducing well even into late succession.....21
20. Blue spruce *(Picea pungens)* is absent or accidental.....22

21. Twinflower *(Linnaea borealis)* is well represented..... **PIPU/LIBO3**, page 103.
21. Twinflower *(Linnaea borealis)* is poorly represented or absent, bittercress ragwort *(Senecio cardamine)* is common..... **PIEN/SECA6**, page 41.

22. Understory essentially shrubby; herbs may be well represented.....23
22. Understory essentially herbaceous.....26

23. Western thimbleberry *(Rubus parviflorus)* is scarce, and common juniper is common.....**ABBI/JUCO6**, page 59.
23. Plants are not as above.....24

24. Western thimbleberry *(Rubus parviflorus)* is well represented.....**ABBI/RUPA**, page 67.
24. Western thimbleberry *(Rubus parviflorus)* is absent or poorly represented.....25

25. Cliffbush *(Jamesia americana)* is present; location is in SE Arizona...**ABBI/JAAM**, page 57.
25. Cliffbush *(Jamesia americana)* is absent or location is otherwise....26

26. Dryspike sedge *(Carex foenea)* is abundant or luxuriant.....**ABBI/CAFO3**, page 51.
26. Dryspike sedge *(Carex foenea)* is absent or present, but not abundant....27

27. Bittercress ragwort *(Senecio cardamine)* is common.....**PIEN/SECA6, ABBI phase**, page 41.
27. Bittercress ragwort *(Senecio cardamine)* is absent or scarce....28

28. Burnet ragwort *(Senecio sanguisorboides)* is common (Sacramento Mtns., southern NM).....**ABBI/SESA6**, page 71.
28. Burnet ragwort *(Senecio sanguisorboides)* is absent or scarce....29

29. Arizona peavine *(Lathyrus lanszwertii* var. *arizonica)* is well represented; sprucefir fleabane *(Erigeron eximius)* is scarce or absent...**ABBI/LALAA3**, page 61.
29. Arizona peavine *(Lathyrus lanszwertii* var. *arizonica)* is poorly represented; sprucefir fleabane *(Erigeron eximius)* is common...**ABBI/EREX4**, page 53.

KEY B: BLUE SPRUCE SERIES

(All page numbers refer to Volume 1: Forests)

1. Forests of streamsides or streamside terraces with riparian obligate shrubs such as alders *(Alnus),* Bebb willow *(Salix bebbiana),* or redosier dogwood *(Cornus sericea)*....**PIPU/COSES**, page 91.
1. Forests without riparian obligate shrubs...2

2. Bittercress ragwort *(Senecio cardamine)* is present, usually in patches (currently known from east central Arizona and adjoining areas in New Mexico)... **PIPU/SECA6**, page 105.
2. Bittercress ragwort *(Senecio cardamine)* is absent....3

3. Ponderosa pine *(Pinus ponderosa)* is a common seral tree (often persisting in late succession)....4
3. Ponderosa pine *(Pinus ponderosa)* is absent or accidental, even in early succession....7

4. Understory bunchgrasses, such as Arizona fescue *(Festuca arizonica)* well represented....**PIPU/FEAR2**, page 99.
4. Understory shrubby or herbaceous, but bunchgrasses are poorly represented...5

5. Kinnikinnick *(Arctostaphylos uva-ursi)* well represented (northern New Mexico or Colorado)...**PIPU/ARUV**, page 83.
5. Kinnikinnick *(Arctostaphylos uva-ursi)* poorly represented 6

6. Grasses and sedges (graminoids) abundant....**PIPU/CAFO3**, page 87.
6. Forbs abundant; graminoids common or well represented in small patches.... **PIPU/EREX4, PIPO phase**, page 95.

7. Twinflower *(Linnaea borealis)* well represented...**PIPU/LIBO3**, page 103.
7. Twinflower *(Linnaea borealis)* absent or poorly represented...**PIPU/EREX4**, page 95.

KEY C: WHITE FIR SERIES

(All page numbers refer to Volume 1: Forests)

1. Herb cover scarce, or no more than 2 species with over 1% canopy coverage; shrubs scarce, except sometimes common juniper is common....**ABCO/MARE11**, page 135.
1. Herbs and/or shrubs at least common....2

2. Location southern New Mexico, particularly in the vicinity of the Lincoln National Forest.....3
2. Location other than southern New Mexico....5

3. Maples *(Acer* spp.) absent; beardless wildrye *(Leymus triticoides)* well represented to abundant....**ABCO/LETR5**, page 133.
3. Maples absent or present; beardless wildrye is poorly represented or absent....4

4. Herb layer is dominated by burnet ragwort *(Senecio sanguisorboides)*..... **ABCO/SESA6**, page 149.
4. Herb layer is not dominated by burnet ragwort 5
5. Walnut *(Juglans major)* common; in drainages (central AZ and southern NM) .....**ABCO/JUMA**, page 127.
5. Walnut absent or scarce.....6

6. Soils are derived from volcanic ash; New Mexico locust is dominant as an understory shrub .....**ABCO/RONE**, page 147.
6. Soils are <u>not</u> derived from volcanic ash; New Mexico locust may be poorly or well represented 7

7. Shrub component of the understory is poorly represented 8
7. Shrub component of the understory is well represented, often abundant 13

8. Graminoids are well represented to abundant, their coverage considerably more conspicuous than forbs....9
8. Forbs are well represented to luxuriant, their coverage exceeding grasses [although fringed brome *(Bromus ciliatus)* is sometimes abundant].....11

9. Screwleaf muhly *(Muhlenbergia virescens)* is common or well represented..... **ABCO/MUVI2**, page 139.
9. Screwleaf muhly is scarce or absent....10

10. Dryspike sedge *(Carex foenea)* is often abundant or luxuriant....**ABCO/CAFO3**, page 117.
10. Dryspike sedge not abundant or absent; Arizona fescue *(Festuca arizonica)* or mountain muhly *(Muhlenbergia montana)* is present....**ABCO/FEAR2**, page 123.

11. Arizona peavine *(Lathyrus lanszwertii* var. *arizonica)* is well represented..... **ABCO/LALAA3**, page 131.
11. Arizona peavine is poorly represented .....12.

12. Sprucefir fleabane *(Erigeron eximius)* is well represented.....**ABCO/EREX4**, page 119.
12. Sprucefir fleabane is poorly represented.....13

13. Maples *(Acer* spp.) or Scouler willow *(Salix scouleriana)* are common....14
13. Maples or Scouler willow are scarce or absent....15

14. Bigtooth maple *(Acer grandidentatum)* is common.....**ABCO/ACGR**, page 111.
14. Bigtooth maple is scarce or absent.....**ABCO/ACGL**, page 107.

15. Gambel oak *(Quercus gambelii)* is well represented....**ABCO/QUGA**, page 143.
15. Gambel oak is poorly represented or absent.....16

16. Whortleberry *(Vaccinium myrtillus)* is well represented to luxuriant..... **ABCO/VAMY2**, page 155.
16. Whortleberry is poorly represented or absent....17

17. Kinnikinnick *(Arctostaphylos uva-ursi)* is well represented.....**ABCO/ARUV**, page 115.
17. Kinnikinnick is poorly represented or absent.....18

18. Whortleleaf snowberry *(Symphoricarpos oreophilus)* is a dominant shrub..... **ABCO/SYOR2**, page 151.
18. Whortleleaf snowberry may be present, but not a dominant shrub...19

19. Arizona peavine *(Lathyrus lanszwertii* var. *arizonica)* is well represented..... **ABCO/LALAA3**, page 131.
19. Sprucefir fleabane *(Erigeron eximius)* is well represented.....**ABCO/EREX4**, page 119.

KEY D: DOUGLAS FIR (& LIMBER PINE) SERIES

(All page numbers refer to Volume 1: Forests)

1. Limber pine *(Pinus flexilis,* not [sw white pine] *Pinus strobiformis)* is a climax tree....2
1. Limber pine is seral or absent...4

2. Kinnikinnick *(Arctostaphylos uva-ursi)* is well represented.....**PIFL2/ ARUV**, page 159.
2. Kinnikinnick is poorly represented or absent.....3

3. Arizona fescue *(Festuca arizonica)* is common.....**PSME/FEAR2, PIFL2 phase**, page 167.
3. Arizona fescue is absent, or scarce (but not due to grazing pressure) ..... **PSME/MUMO, PIFL2 phase**, page 175.

4. Bigtooth maple common (location generally in southern Arizona or adjoining areas) .....**PSME/ACGR**, page 161.
4. Bigtooth maple scarce or absent.....5

5. Species of oak well represented 6
5. Species of oak poorly represented 9

6. Wavyleaf oak *(Quercus* X *pauciloba)* is well represented....**PSME/QUPA4**, page 191.
6. Wavyleaf oak is poorly represented or absent 7

7. Gambel oak *(Quercus gambelii)* is well represented ....**PSME/QUGA**, page 183.
7. Gambel oak is poorly represented or absent 8

8. Silverleaf oak *(Quercus hypoleucoides)* is common .... **PSME/QUHY**, page 187.
8. Silverleaf oak is scarce or absent ..... **PSME/QUAR**, page 181.

9. Kinnikinnick *(Arctostaphylos uva-ursi)* is abundant; other shrubs are poorly represented.....**PSME/ARUV**, page 163.
9. Kinnikinnick is absent or not abundant.....10

10. Herb cover poorly represented, or if well represented, rock spirea *(Holodiscus dumosus)* is common.....11
10. Herb cover well represented to luxuriant....12

11. Rock spirea is common (location southern or central New Mexico)..... **PSME/HODU**, page 171.
11. Rock spirea absent or scarce.....**PSME/MARE11**, page 173.

12. Screwleaf muhly *(Muhlenbergia virescens)* is common.....**PSME/MUVI2**, page 177.
12. Screwleaf muhly is absent or scarce....13

13. Arizona fescue *(Festuca arizonica)* or Kentucky bluegrass *(Poa pratensis)* common; shrubs poorly represented ..... **PSME/FEAR2**, page 167.
13. Grasses not as described above 14

14. Herb cover luxuriant; fringed brome *(Bromus ciliatus)* is usually abundant... **PSME/BRCI**, page 165.
14. Herb cover is not luxuriant, but may be well represented to abundant....15

15. Ponderosa pine *(Pinus ponderosa)* absent or seral 16
15. Ponderosa pine climax; Douglas-fir *(Pseudotsuga menzensii)* is sometimes co-climax 17

16. Aspen *(Populus tremuloides)* is a major seral tree ..... **ABCO/ACGL**, page 107.
16. Aspen is absent or scarce even in young stands ..... **PSME/PHMO4**, page 179.

17. Cliffrose *(Purshia stansburyiana)* is well represented .....**PIPO/PUST**, page 219.
17. Cliffrose is scarce or absent ..... **PSME/MUMO**, page 175.

KEY E: PONDEROSA PINE SERIES

(All page numbers refer to Volume 1: Forests)

1. Very open forests on sanddunes, cinders or rockland.....2
1. Forests and environments otherwise.....4

2. Rockland (soils <4" deep over most of area)..... **PIPO/rockland**, page 239.
2. Sandy or cindery soils 3

3. Sandy soils; hoary rosemint *(Poliomintha incana)* present...**PIPO/ORHY**, p. 217.
3. Soils of volcanic cinder cones .....**PIPO/BOGR2, ANHA phase**, page 199.

4. Walnut *(Juglans major)* or canyon grape *(Vitis arizonica)* common; on terraces of intermittent washes or streamsides (central & southern AZ, SW NM) .....**PIPO/JUMA**, page 207.
4. Above species scarce or absent 5

5. Oaks *(Quercus* spp.) and/or New Mexico locust *(Robinia neomexicana)* are well represented 6
5. Oaks absent or poorly represented.....14

6. Gambel oak *(Quercus gambelii)* and/or New Mexico locust *(Robinia neomexicana)* are well represented as trees or shrubs; and Gambel oak is the dominant oak ..... **PIPO/QUGA**, page 227.
6. Gambel oak is poorly represented or absent, or not the dominant oak.....7

7. Oak species include Arizona white oak *(Quercus arizonica)*, Emory oak *(Quercus emoryi)*, silverleaf oak *(Quercus hypoleucoides)*, or netleaf oak *(Quercus rugosa)* [location is below the Mogollon Rim or adjoining areas of SW NM)]...8
7. Oak species above are not present [may include Gray oak or wavyleaf oak *(Quercus* X*pauciloba)*]...13

8. Species of manzanita *(Arctostaphylos* spp.) usually abundant.... **PIPO/ARPU5**, page 195.
8. Species of manzanita not abundant or absent....9

9. Silverleaf oak *(Quercus hypoleucoides)* is well represented.....**PIPO/QUHY**, page 233.
9. Silverleaf oak is poorly represented or absent...10

10. Emory oak *(Quercus emoryi)* is well represented along drainages with granitic soils....**PIPO/QUEM**, page 225.
10. Emory oak is poorly represented or absent, or environments otherwise...11

11. Netleaf oak *(Quercus rugosa)* at least common, usually well represented or abundant....**PIPO/QURU4**, page 237.
11. Netleaf oak is scarce or absent.....12

12. Mountain muhly *(Muhlenbergia montana)* is well represented.... **PIPO/MUMO**, page 209.
12. Mountain muhly is poorly represented or absent.....**PIPO/QUAR**, page 221.

13. Gray oak *(Quercus grisea)* is common.... **PIPO/QUGR3**, page 231.
13. Gray oak is scarce, wavyleaf oak is common....**PIPO/QUPA4**, page 235.

14. Understory essentially grassy, shrubs poorly represented....15
14. Shrubs are well represented in the understory....19

15. Arizona fescue *(Festuca arizonica)* present, or screwleaf muhly *(Muhlenbergia virescens)* common or Kentucky bluegrass *(Poa pratensis)* well represented...16
15. Grasses not as described above....18

16. Arizona fescue is present, usually at least common, or Kentucky bluegrass is well represented; screwleaf muhly is absent to well represented.....17
16. Arizona fescue is absent; screwleaf muhly is common to abundant.... **PIPO/MUVI2**, page 213.

17. Screwleaf muhly *(Muhlenbergia virescens)* is at least common.... **PIPO/MUVI2-FEAR2**, page 215.
17. Screwleaf muhly is scarce or absent.... **PIPO/FEAR2**, page 203.

18. Mountain muhly *(Muhlenbergia montana)* is well represented.... **PIPO/MUMO**, page 209.
18. Mountain muhly is poorly represented; blue grama *(Bouteloua gracilis)* is usually well represented (if poorly represented, pinyon or alligator juniper are common).....**PIPO/BOGR2**, page 199.

19. Manzanita *(Arctostaphylos* spp.) is well represented, usually abundant (location is south of Mogollon Rim).....**PIPO/ARPU5**, page 195.
19. Manzanita is poorly represented or absent....20

20. Kinnikinnick *(Arctostaphylos uva-ursi)* is well represented...**PIPO/ARUV**, page 197.
20. Kinnikinnick is poorly represented or absent.....21

21. Cliffrose *(Purshia stansburyiana)*, bitterbrush *(Purshia tridentata)*, or their hybrids are well represented.....**PIPO/PUST**, page 219.
21. Above shrubs are poorly represented or absent....22

22. Black sagebrush *(Artemisia nova)* is well represented (northern NM or northern AZ).....**PIPO/ARNO4**, page 193.
22. Big sagebrush *(Artemisia tridentata)* is well represented.....**PIPO/BOGR2, ARTR2 phase**, page 199.

KEY F: APACHE PINE AND CHIHUAHUAN PINE SERIES

(All page numbers refer to Volume 1: Forests)

1. Apache pine *(Pinus engelmannii)* present....2
1. Apache pine *(Pinus engelmannii)* absent....3

2. Silverleaf oak *(Quercus hypoleucoides)* or netleaf oak *(Quercus rugosa)* are dominant in the understory....**PIEN2/QUHY**, page 249.
2. Silverleaf oak and/or netleaf oak are poorly represented and subdominant, or absent ....**PIEN2/MULO**, page 247.

3. Pinyon ricegrass *(Piptochaetium fimbriatum)* mostly well represented or abundant .....**PILE/PIFI**, page 241.
3. Pinyon ricegrass usually poorly represented....4

4. Silverleaf oak *(Quercus hypoleucoides)* is the leading oak.....**PILE/QUHY**, page 245.
4. Silverleaf oak is minor among other oaks....**PILE/QUAR**, page 243.

KEY G: RIPARIAN FORESTS

(All page numbers refer to Volume 1: Forests. Except where noted see page 301.)

1. Narrowleaf cottonwood *(Populus angustifolia)* well represented.....**POAN series**
1. Narrowleaf cottonwood poorly represented.....2

2. Essentially coniferous forest [aspen may be present].....3
2. Forests not strictly coniferous.....5

3. Corkbark fir *(Abies bifolia)* and /or Engelmann spruce *Picea engelmannii)* dominates the overstory along streams.....**ABBI (riparian) series**
3. Corkbark fir is not dominant in the overstory.....4

4. Blue spruce *(Picea pungens)* dominates the overstory along streams.....PIPU (riparian) series (see **PIPU/COSES** in PIPU key), page 91.
4. White fir *(Abies concolor)*, Douglas-fir *(Pseudotsuga menzensii)*, and/or aspen *(Populus tremuloides)* codominates the overstory along streams..... ABCO (riparian) series (see **ABCO/JUMA** in ABCO key), page 127.

5. Alder *(Alnus)* thickets line streamsides.....6
5. Alders not dominant in the overstory.....7

6. Arizona alder *(Alnus oblongifolia)* common.....**POAN3 series**
6. Thinleaf alder *(Alnus incana* ssp. *tenuifolia)* dominant.....**ALINT series**

7. Arizona sycamore *(Platanus wrightii)* common.....**PLWR2 series**
7. Arizona sycamore scarce or absent.....8

8. Rio Grande cottonwood *(Populus deltoides* ssp. *wislizensi)* common.... **PODEW series**
8. Rio Grande cottonwood scarce or absent.....in a series not covered in this key.

KEY H: MADREAN OAK WOODLANDS

(All page numbers refer to Volume 2: Woodlands.)

1. Mexican blue oak *(Quercus oblongifolia)* common....2
1. Mexican blue oak absent or scarce....3

2. Savannas of gentle slopes or deep, alluvial soils....**QUOB/mixed Bouteloua**, page 49.
2. Savannas usually of moderate or steep colluvial slopes.....**QUOB/DAWH2**, page 51.

3. Gray oak *(Quercus grisea)* is well represented....4
3. Gray oak is poorly represented or absent....5

4. Essentially grassy understory....**QUGR3/BOCU**, page 35.
4. Essentially shrubby understory (chaparral woodland).....**QUGR3/CEMO2**, page 37.

5. Emory oak *(Quercus emoryi)* is well represented....6
5. Emory oak is poorly represented or absent 12

6. Tall (>30 ft.) Emory oak on dry terraces along drainages.....**QUEM/JUMA**, page 45.
6. Shorter trees in other environments....7

7. Generally open woodlands with grassy understories (savannas)....8
7. Closed woodlands or woodlands with shrubby understories...9

8. Savannas on mostly alluvial soils....**QUEM/BOCU**, page 41.
8. Savannas on mostly moderate or steep colluvial slopes.....**QUEM/DAWH2**, page 43.

9. Shrubs abundant or luxuriant....10
9. Shrubs common or well represented....12

10. Manzanita *(Arctostaphylos pungens)* common to abundant....**QUEM/ARPU5**, page 39.
10. Manzanita scarce or absent....11

11. Shrub live oak *(Quercus turbinella)* well represented....**PIFA/QUTU2**, page 99.
11. Shrub live oak poorly represented....**PIED (or PIFA)/CEMO2**, page 65.

12. Silverleaf oak *(Quercus hypoleucoides)* well represented....13
12. Silverleaf oak poorly represented 14

13. Longtongue muhly *(Muhlenbergia longiligula)* usually common; mature oaks are trees (not shrubs)....**QUHY/MULO**, page 47.
13. Longtongue muhly scarce; mature oaks are shrubby....**PIDI3/QUHY**, page 109.

14. Grasses poorly represented....**QUAR/RHTR**, page 33.
14. Grasses well represented to abundant....15

15. Savannas mostly of moderate or steep colluvial slopes..**QUAR/MUEM**, page 29.
15. Savannas on mostly alluvial soils....16

16. Utah juniper *(Juniperus osteosperma)* well represented.....**PIFA/BOGR2**, page 95.
16. Utah juniper poorly represented or absent....**QUAR/PIFI**, page 31.

KEY I: PINYON PINE SERIES

(All page numbers refer to Volume 2: Woodlands.)

1. Herbs are scarce; shrubs scarce or common....2
1. Both herbs and shrubs are at least common....6

2. Open woodlands on rockland (soils < 4" deep)...**PIED/rockland**, page 87.
2. Soils > 4" deep.....3

3. Soils clearly erosional (dissected by active rills and gullies)...4
3. Soils not actively rilled or gullied (sheet erosion may be occurring)[location is central to southern Arizona] ....**PIFA/YUBA**, page 101.

4. Pinyon pine is twoneedle pinyon *(Pinus edulis)*.....**PIED/sparse**, page 89.
4. Pinyon pine is either Arizona pinyon *(Pinus fallax)* or border pinyon *(Pinus discolor)* [geographic location is below the Mogollon Rim in Arizona or adjoining areas of New Mexico]....5

5. Arizona pinyon is the dominant pinyon....**PIFA/sparse**, page 89.
5. Border pinyon is the dominant pinyon....**PIDI3/sparse**, page 89.

6. Gambel oak *(Quercus gambelii)* is well represented....**PIED/QUGA**, page 83.
6. Gambel oak *(Quercus gambelii)* is poorly represented....7

7. Rubber rabbitbrush *(Chrysothamnus nauseosus)* or Apacheplume *(Fallugia paradoxa)* are common to abundant along washes...8
7. Not as above...9

8. The pinyon is twoneedle pinyon *(Pinus edulis)*....**PIED/CHNA2-FAPA**, page 67.
8. The pinyon is Arizona pinyon *(Pinus fallax)* [single needle].....**PIFA/CHNA2-FAPA**, page 94.
8. The pinyon is Mexican pinyon *(Pinus discolor)* [3-needle pinyon].....**PIDI/CHNA2-FAPA**, page 67.

9. Geographic location is south of the Mogollon Rim and adjoining areas....10
9. Geographic location is other locations in Arizona and New Mexico not described above....22

10. Essentially grassy woodlands; shrubs scarce to well represented....11
10. Essentially shrubby woodlands; shrubs well represented to abundant; grasses poorly represented....14

11. Border pine *(Pinus discolor)* common to well represented....12
11. Arizona pine *(Pinus fallax)* or twoneedle pine *(Pinus edulis)* common to well represented....13

12. Colluvial soils often of moderate to steep slopes....**PIDI3/MUEM**, page 105.
12. Alluvial soils of valleys or gentle lower slopes....**PIDI3/PIFI**, page 107.

13. Utah juniper is the leading juniper.....**PIFA/BOGR2, JUOS phase**, page 95.
13. Alligator juniper is the leading juniper....**PIFA/BOGR2, JUDE2 phase**, page 95.

14. Crucifixion thorn *(Canotia holacantha)* present.....**PIFA/CAHO3**, page 197.
14. Crucifixion thorn absent.....15

15. Mountain mahogany *(Cercocarpus* spp.) well represented....16
15. Mountain mahogany poorly represented....17

16. Twoneedle pinyon *(Pinus edulis)* well represented....**PIED/CEMO2**, page 65.
16. Border pinyon *(Pinus discolor)* well represented.....**PIDI3/RHVIC**, page 113.

17. Oaks well represented to abundant in understory....18
17. Oaks (as understory) poorly represented or absent...**PIDI3/CHDUA**, page 103.

18. Toumey oak *(Quercus toumeyi)* or its hybrids are present.....**PIDI3/QUTO2**, page 111.
18. Toumey oak or its hybrids are absent....19

19. Silverleaf oak *(Quercus hypoleucoides)* is common.....**PIDI3/QUHY**, page 109.
19. Silverleaf oak is scarce or absent.....20.

20. Manzanita *(Arctostaphylos pungens)* is scarce or absent.....**PIFA/QUTU2**, page 99.
20. Manzanita is at least common....21

21. Arizona pinyon *(Pinus fallax)* is well represented....**PIFA/ARPU5**, page 93.
21. Twoneedle pinyon *(Pinus edulis)* or border pinyon *(Pinus discolor)* or mixtures of these pinyons are well represented....**PIED (PIDI3)/ARPU5**, page 55.

22. Manzanita *(Arctostaphylos pungens)* or blackbrush *(Coleogyne ramosissima)* well represented....23
22. Manzantia or blackbrush scarce or absent....24

23. Manzanita is well represented....**PIED/ARPU5** or **PIFA/ARPU5**, page 55.
23. Blackbrush is well represented....**PIED/CORA**, page 69.

24. Oaks are well represented....25
24. Oaks are poorly represented....34

25. Gray oak *(Quercus grisea)* is dominant, twoneedle pinyon is common (mostly in NM)....**PIED/CEMO2**, page 65.
25. Other oaks are dominant [including Arizona white oak *(Quercus arizonica)*, Gambel oak *(Quercus gambelii)*, and wavyleaf oak *(Quercus* X*pauciloba)*]....26

26. Arizona white oak is dominant.....27
26. Other oaks are dominant.....29

27. Border pinyon *(Pinus discolor)* is common....**PIDI3/MUEM**, page 105.
27. Border pinyon is absent or scarce.....28

28. Perennial herbs are scarce....**QUAR/RHTR**, page 33.
28. Perennial herbs (especially grasses) are at least common..**QUAR/PIFI**, page 31.

29. Wavyleaf oak *(Quercus* X*pauciloba)* is at least common.....30
29. Wavyleaf oak is absent or scarce.....**PIED/QUGA**, page 83.

30. Understory is essentially shrubby; true mountain mahogany *(Cercocarpus montanus)* or wavyleaf oak is common or well represented.....31
30. Understory is essentially grassy.....32

31. True mountain mahogany is common or well represented.....**PIED/CEMO2**, page 65.
31. True mountain mahogany is scarce; wavyleaf oak is well represented or abundant....**PIED/QUPA4**, page 85.

32. Pine muhly *(Muhlenbergia dubia)* is common.....**PIED/MUDU**, page 73.
32. Pine muhly is absent or scarce.....33
33. Twoneedle pinyon *(Pinus edulis)* is second to oneseed juniper *(Juniperus monosperma)* in cover...**PIED/MUPA2**, page 75.
33. Twoneedle pinyon and oneseed juniper are codominants.....**PIED/STNED**, page 91.

34. Understory essentially shrubby; shrubs well represented or abundant...35
34. Understory essentially grassy; shrubs scarce to well represented...41

35. True mountain mahogany *(Cercocarpus montanus)* common or well represented....36
35. True mountain mahogany scarce or absent....37

36. Gambel oak *(Quercus gambelii)* common; true mountain mahogany poorly represented....**PIED/QUGA**, page 83.
36. Gambel oak present or absent; true mountain mahogany well represented....**PIED/CEMO2**, page 65.

37. Sandy soils; sand sagebrush *(Artemisia filifolia)* or sand bluestem *(Andropogon hallii)* present to abundant.....**PIED/ANHA**, page 53.
37. Soils otherwise; sand sagebrush or sand bluestem scarce or absent....38

38. Big sagebrush *(Artemisia tridentata)* or antelope bitterbrush *(Purshia tridentata)* common or well represented (northern AZ or northern NM); cliffrose *(Purshia stansburyiana)* present or absent....39
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KEY J: JUNIPER WOODLANDS

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Arizona cypress/silverleaf oak
Cupressus arizonica/
Quercus hypoleucoides

CUAR/QUHY

CODES

typic phase 0 31 01

KEY CRITERIA

Chaparral or woodlands of elevations less than 6,000' (1830 m) with ***Arizona cypress** mixed with oaks, pinyons and junipers, also lacking significant presence of spruces, firs and Douglas-fir; ***silverleaf oak common**.

LOCATION

Slopes and drainages on a wide variety of landforms, parent materials, and soils; often cool north or east slopes, or sites with high subsurface water tables or lateral flows; at elevations from 4,800' to 5,800' (1,460 to 1,770 m); Woods Canyon, Arizona, Dragoon, Santa Catalina, and Chiricahua Mountains of southeastern Arizona.

ADJACENT PLANT ASSOCIATIONS

Arizona cypress is likely to border a wide variety of other woodland and shrub communities including those dominated by juniper, mesquite, oak, pinyon or pine.

ALSO SEE

TES mapping units 714 and 720 and *Cupressus arizonica*/*Pinus discolor*/*Quercus hypoleucoides* subseries for Apache National Forest (USFS 1987b); Parker (1980ab). Moir and Lukens (1976), Wetter habitats containing *Cupressus arizonica* are riparian forests. CUAR/QUTU2 is a drier h.t. lacking silverleaf oak.

TREES

Luxuriant (>50% cover)**:**
* **Arizona cypress** *(Cupressus arizonica)*
border pinyon pine *(Pinus discolor)*
***silverleaf oak** *(Quercus hypoleucoides)*
canyon liveoak *(Quercus chrysolepis)*
Arizona white oak *(Quercus arizonica)*

SHRUBS

Well represented (>5% cover)**:**
netleaf oak *(Quercus rugosa)*
pointleaf manzanita *(Arctostaphylos pungens)*
true mountain mahogany *(Cercocarpus montanus)*
cliff fendlerbush *(Fendlera rupicola)*
Wright silktassel *(Garrya wrightii)*
Fendler ceanothus *(Ceanothus fenderli)*
sacahuista *(Nolina microcarpa)*
singleleaf ash *(Fraxinus anomala)*
common chokecherry *(Prunus virginiana)*

HERBS

Common (>1% cover)**:**
sideoats grama *(Bouteloua curtipendula)*
muttongrass *(Poa fendleriana)*
white Mountain sedge *(Carex geophila)*
prairie junegrass *(Koeleria macrantha)*
Pringle speargrass *(Piptochaetium pringlei)*
needlegrasses (*Stipa* spp.)
bottlebrush squirreltail *(Elymus elymoides)*
little bluestem *(Schizachyrium scoparium)*
longtongue muhly *(Muhlenbergia longiligula)*
mat muhly *(Muhlenbergia richardsonii)*
New Mexico groundsel *(Senecio neomexicanus)*

BRIEF PLANT ID NOTES

Arizona cypress is a medium-sized native, evergreen, scale-leaved tree; mature trees range from 30' to 90' (9 to 19 meters) in height. It has a conical or rounded crown, a straight trunk with bark that varies from smooth and reddish to rough, furrowed and fibrous or checkered. Leaves are minute, overlapping, pointed, pale green scales. The fruit is a persistent globe-shaped cone with 6-8 scales, each with a prickle in the center.

SYNONYMY

(Stipa pringlei = Piptochaetium pringlei)
bottlebrush squirreltail *(Sitanion hystrix = Elymus elymoides)*
little bluestem *(Andropogon scoparius = Schizachyrium scoparium)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: +1 (cool, wet)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

Mosaic patterns of different aged stands of uniform height and density are due to the patchy nature of surface fires which typically kill some but not all trees. Seedlings and saplings (diameters <4 inches [10cm]) have almost no resistance to even low-intensity surface fires. Surface fire may kill all seeds in cones on the ground (Parker 1980). Larger trees exhibit little fire resistance also. Crown fires may actually open cones on the tree, killing a portion of the seeds in the cone (Vogl *et al*. 1977).

Arizona cypress owes to fire disturbance a tenuous existence. Too frequent fires can wipeout a grove, yet fire is needed sometime in its history to produce conditions for reproduction. Moir (1982) suggested that low-intensity surface fires with a frequency of 50 to 60 years serve to thin out Mexican pinyon thickets which could eventually exclude Arizona cypress. Fire frequencies exceeding 80 years may allow fuel buildup and produce a shift in dominance patterns from those species that are maintained by recurrent fire. (Swetnam *et al*. 1989)

REFORESTATION

Wood harvesting methods: Clearcutting favors oak. Partial overstory removal such as selection cutting favors Arizona cypress where there is more residual canopy, and favors oak with less dense overstory.

Where soil texture and slopes are suitable, mechanical site prep generally favors oak regeneration. Burning favors oak and cypress. No disturbance favors cypress regeneration.

REVEGETATION CONSIDERATIONS

See CUAR/QUTU2.

COMMENTS

Natural disturbance such as flooding: favors Arizona cypress.

The forage value rating for cattle in early seral stages is moderate and in late seral is low.

REFERENCES

Carmichael *et al*. 1978
Little 1950
Moir 1982
Moir and Lukens 1979
Parker 1980a
Smith 1974
Swetnam *et al*. 1989
USFS 1986
USFS 1987b
USFS 1986 A-S TES

Arizona cypress/shrub live oak
Cupressus arizonica/
Quercus turbinella

CUAR/QUTU2

CODES

typic phase 0 31 02

KEY CRITERIA

Chaparral or woodlands of elevations less than 6,000' (1830 m) with ***Arizona cypress** mixed with oaks, pinyons and junipers, also lacking significant presence of spruces, firs and Douglas-fir. Silverleaf oak absent or accidental.

LOCATION

Moderately steep canyon slopes or alluvial toeslopes with mostly northerly aspects; at elevations from 4,800' to 5,800' (1,460 to 1,770 m); distribution includes Wood Canyon near Clifton, in vicinity of Sedona, local elsewhere in southern and southeastern Arizona; also, north of Cooke's Peak, NM.

ALSO SEE

Arizona cypress-shrub live oak association (Carmichael *et al*. 1987), CUGL-PIFA-QUTU2-ARPU5 (mapping units 4468, 4469) on the Tonto NF (USFS 1986c): Parker 1980b.

Information on stand structure and productivity and adjacent plant associations are not available.

TREES

Luxuriant (>50% cover)**:**
*__Arizona cypress__ *(Cupressus arizonica)*
two needle pinyon pine *(Pinus edulis)*
Arizona pinyon *(Pinus fallax)*
Utah juniper *(Juniperus osteosperma)*

SHRUBS

Well represented (>5% cover)**:**
canyon live oak *(Quercus chrysolepis)*
shrub live oak *(Quercus turbinella)*
pointleaf manzanita *(Arctostaphylos pungens)*
Pringle manzanita *(Arctostaphylos pringlei)*
Wright silktassel *(Garrya wrightii)*
desert ceanothus *(Ceanothus greggii)*
sugar sumac *(Rhus ovata)*
true mountain mahogany *(Cercocarpus montanus)*
Stansbury cliffrose *(Purshia stanburiana)*
cliff fendlerbush *(Fendler rupicola)*
singleleaf ash *(Fraxinus anomala)*
mimosa (*Mimosa aculealicarpa* var *biuncifera)*
redleaf holly *(Rhamnus crocea)*

HERBS

Scarce (<1% cover)**:** Scarcity of herbs due to strong tree and shrub dominance.

BRIEF PLANT ID NOTES

Arizona cypress is a medium-sized native, evergreen, scale-leaved tree; mature trees range from 30' to 90' (9 to 19 meters) in height. It has a conical or rounded crown, a straight trunk with bark that varies from smooth and reddish to rough, furrowed and fibrous or checkered. Leaves are minute, overlapping, pointed, pale green scales. The fruit is a persistent globe-shaped cone with 6-8 scales, each with a prickle in the center.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
Climate Class: LSM (low sun mild)

PHASES

Although no phases are described, the description of this plant association covers elevational subzones ranging from +1 through -1, and phase designations may be needed to distinguish mesic from xeric sites.

FIRE ECOLOGY

Arizona cypress tends to occur in mosaics of different aged stands of uniform height and density; a condition due to the patchy nature of surface fires which typically kill some but not all trees. Seedlings and saplings (diameters <4 inches [10cm]) have almost no resistance to even low-intensity surface fires. Surface fire will kill all seeds in cones on the ground (Parker 1980). Larger trees exhibit little fire resistance also. Crown fires may actually open cones on the tree, killing a portion of the seeds in the cone (Vogl *et al*. 1977).

Arizona cypress owes a tenuous existence to fire disturbance. Too frequent fires can wipeout a grove, yet fire is needed sometime in its history to produce conditions for reproduction. Moir (1982) suggested that low-intensity surface fires with a frequency of 50 to 60 years serve to thin out Mexican pinyon thickets which could eventually exclude Arizona cypress. Fire frequencies exceeding 80 years may allow fuel buildup and produce a shift in dominance patterns from those species that are maintained by recurrent fire.

REFORESTATION

Wood harvesting methods: Clearcutting and seedtree harvest methods favor oak. Partial overstory removal such as selection cutting favors Arizona cypress where there is more residual canopy, and favors oak with less dense overstory.

__Where soil texture and slopes are suitable, mechanical site prep generally favors oak regeneration. Burning favors oak and cypress. No disturbance favors cypress regeneration.

REVEGETATION CONSIDERATIONS

Community development of Arizona cypress follows various multiple pathways (See Parker 1980ab). Arizona cypress is considered a pioneer species. It is intolerant of litter accumulation, is tolerant of low light levels and exhibits in-cone seed persistence. It may or may not depend on seed dispersal from distance sources to colonize any given disturbed site. It does however require disturbance to reproduce: thus, flooding, human-caused activities, or fire at frequencies less than its longevity and at intensities or circumstances that result in removal of litter accumulation, rather than stand replacement, can trigger regeneration (Parker 1980ab).

COMMENTS

Natural disturbance such as flooding favors Arizona cypress.

The forage value rating for cattle in early seral is low and in late seral is none due to paucity of species beneath enclosed crowns.

REFERENCES

Carmichael *et al*. 1978
Little 1950
Moir 1982
Parker 1980a, 1980b
USFS 1986
USFS 1987b
USFS 1986 A-S TES

Arizona white oak/bullgrass
Quercus arizonica/
Muhlenbergia emersleyi

QUAR/MUEM

CODE(S)

typic phase 6 30 03 0

KEY CRITERIA

Oak savannas on mostly moderate to steep colluvial slopes below 6,200' (1890 m) with Arizona white oak and other oaks, pinyons and junipers with grasses well represented (>5% cover).

LOCATION

Canyon and piedmont hill slopes of highly variable parent materials and soils; at elevations from 4,800' to 6,200' (1,460 to 1,890 m); Animas, Peloncillo, Burro Mountains of southwest New Mexico and adjoining southeastern Arizona; being extensive south of the Mogollon Rim in Arizona, and is very local elsewhere.

ALSO SEE

If twoneedle pinyon and alligator juniper (taken together) exceed Arizona white oak in coverage, then see PIED-QUAR/RHTR or PIED-QUAR/PIFI. Along the Arizona-New Mexico border, Arizona white oak and gray oak hybridize and these oaks and their progeny may not be distinguishable.

Open woodland (lower encinal) of Wittaker and Niering (1965) and Wagner (1977); Arizona white oak savanna (Moir 1979, Wallmo 1955). QUGR/BOCU (USFS 1986a) mostly in southern New Mexico is very similar but lacks some of the Madrean plant species of QUAR/MUEM. In the Glenwood RD, see Terrestrial Ecosystems Survey map units 4836 and 4850 (USFS 1985).

TREES

Well represented (>5% cover)**:**
Arizona white oak *(Quercus arizonica)*
Emory oak *(Quercus emoryi)*
alligator juniper *(Juniperus deppeana)*
twoneedle pinyon *(Pinus edulis)*
border pinyon pine *(Pinus discolor)*
silverleaf oak *(Quercus hypoleucoides)*
at <5% cover when present

SHRUBS

Common (>1% cover) to well represented (>5% cover)**:**
sacahuista *(Nolina microcarpa)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush *(Ericameria laricifolia)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
pricklypear cacti (*Opuntia* spp.)
common sotol *(Dasylirion wheeleri)*
Wright silktassel *(Garrya wrightii)*
pointleaf manzanita *(Arctostaphylos pungens)*
hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus)*
Palmer century plant *(Agave palmeri)*
Schott yucca *(Yucca schottii)*
prairie acacia *(Acacia angustissima)*
Arizona Mexican orange *(Choisya dumosa* var. *arizonica)*
walkingstick cactus *(Opuntia spinosior)*

HERBS

Well represented (>5% cover) to abundant (>25% cover)**:**
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*

blue grama *(Bouteloua gracilis)*
common wolftail *(Lycurus phleoides)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
bulb panicgrass *(Panicum bulbosum)*
bean (*Phaseolus* spp.)
ticktrefoil (*Desmodium* spp.)

BRIEF PLANT ID NOTES

Some additional shrubs and herbs of canyon oak woodlands include:
Apaceplume *(Fallugia paradoxa)*
California brickellbush *(Brickellia californica)*
western white honeysuckle *(Lonicera albiflora)*
Thurber desert honeysuckle *(Anisacanthus thurberi)*
green sprangletop *(Leptochloa dubia)* [occasional on drier slopes].

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus = C. breviflorus*)
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

Historically fires probably occurred about every 10 to 20 years in oak woodlands adjacent to semidesert grasslands; and every 1 to 38 years in the Chiricahua National Monument. (Pavek 1994c)

Small Arizona white oak are top-killed by fire. Larger trees usually survive low intensity fires. Its foliage is highly flammable. Fires move quickly through oak woodlands that have a continuous grass understory. Surviving stumps sprout vigorously. Acorns not buried in the soil probably do not survive even low intensity fire.

COMMENTS

MAP = 19"/yr, MAAT = 55 degrees F; dry season typically May and June. In canyon bottoms, trees often become more dense and taller (cover is abundant or luxuriant). This woodland is sometimes called closed encinal or canyon oak woodland.

REFERENCES

USFS 1986
USFS 1987b
Pavek 1994c

Arizona white oak/pinyon ricegrass
Quercus arizonica/
Piptochaetium fimbriatum

QUAR/PIFI

SYNONYMS

Pinus edulis-Quercus arizonica/ Piptochaetium fimbriatum (USFS 1987b)

CODE(S)

typic phase 6 30 05 0

KEY CRITERIA

Oak woodland of typically dry soils with Arizona white oak and other oaks, pinyons and junipers. Grasses well represented (>5% cover) with pinyon ricegrass present among abundant herb ground cover. Utah juniper may be poorly represented (<5% cover) or absent.

STRUCTURE

Both QUAR/PIFI and QUAR/RHTR may be successionally related by means of interaction between tree overstory and herbaceous understory, or they may be distinct habitat types. More study is needed.

LOCATION

Deep alluvium along dry washes (cumulic and fluventic soils); at elevations from 5,400' to 5,800' (1,645 to 1,770 m); local in southwest New Mexico and south of the Mogollon Rim in Arizona, and is very local elsewhere.

ADJACENT PLANT ASSOCIATIONS

Intergrades with QUAR/MUEM on certain sites.

ALSO SEE

QUEM/JUMA on similar sites at lower elevations; Cumulic Haplustolls component of map unit 4836 in TES for part of the Glenwood RD. If Arizona sycamore is common, see riparian forests.

TREES

Luxuriant (>50% cover):
Arizona white oak *(Quercus arizonica)*
Emory oak *(Quercus emoryi)*
alligator juniper *(Juniperus deppeana)*
twoneedle pinyon *(Pinus edulis)*—
in some locations
border pinyon pine *(Pinus discolor)*
Arizona walnut *(Juglans major)*

SHRUBS

Well represented (>5% cover):
rubber rabbitbrush
(Chrysothamnus nauseosus)
skunkbush sumac *(Rhus trilobata)*
canyon grape *(Vitis arizonica)*
pointleaf manzanita *(Arctostaphylos pungens)*
Wright silktassel *(Garrya wrightii)*
sacahuista *(Nolina microcarpa)*
broom snakeweed *(Guiterrizia sarothae)*

HERBS

Usually abundant (>25% cover):
pinyon ricegrass *(Piptochaetium fimbriatum)*
nodding brome *(Bromus anomolus)*
single threeawn *(Aristida orcuttiana)*
muttongrass *(Poa fendleriana)*
longtongue muhly *(Muhlenbergia longiligula)*
bullgrass *(Muhlenbergia emersleyi)*
deergrass *(Muhlenbergia rigens)*
prairie junegrass *(Koeleria macrantha)*
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
Texas bluestem *(Schizachyrium cirratum)*
Carruth sagewort *(Artemisia carruthii)*
Louisiana sagewort *(Artemisia ludoviciana*
plains lovegrass *(Eragrostis intermedia)*
bean (*Phaseolus* spp.)

SYNONYMY

Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
Climate Class: HSM (high sun mild)

REFERENCES

USFS 1987b

Arizona white oak/ skunkbush sumac Quercus arizonica/Rhus trilobata

QUAR/RHTR

SYNONYMS

Pinus edulis-Quercus arizonica/Rhus trilobata (USFS 1986a)

CODE(S)

alligator juniper (JUDE2) phase	6 30 04 1
oneseed juniper (JUMO) phase	6 30 04 2
pinyon ricegrass (PIFA) phase	6 30 04 3

KEY CRITERIA

Closed oak woodlands with reduced herb ground cover and grasses poorly represented (<5% cover); with Arizona white oak and other oaks, pinyons and junipers.

STRUCTURE

Arizona white oak is a climax species in Madrean evergreen oak and encinal woodlands (Layser and Schubert 1979, in USFS/ FEIS). QUAR/PIFI differs primarily by the well developed herbaceous understory. Encinal woodlands, Madrean oak woodlands. The pine-oak woodland of Marshall (1957) features emergent pines *(Pinus leiophylla, P. Engelmannii, P. Ponderosa*) above the upper oak canopy. The QUAR/MUEM habitat type is a grassy savanna (open encinal), whereas QUAR/RHTR is more a closed woodland with reduced herbaceous understory.

The forage value rating for cattle in early seral stage is moderate and in late seral stage is low due to shading of typically closed crown cover.

LOCATION

Known from a wide variety of land forms, parent materials, and soils; at elevations from 5,000' to 7,000' (1,540 to 2,130 m); southern New Mexico and Arizona; being more common south of the Mogollon Rim in Arizona.

ADJACENT PLANT ASSOCIATIONS

QUAR/MUEM; scarp woodlands.

ALSO SEE

See also the canyon oak woodlands (e.g. Moir 1979). In the Clifton RD (Apache NF), see TES mapping units 236, 575, 612, 620, 632, 634 of the PIED-JUDE2-JUMO-QUGR3 subseries; MUs 130 and 154 of this subseries can also be regarded as containing scarp woodland (USFS 1987b).

TREES

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

Arizona white oak *(Quercus arizonica)*
gray oak *(Quercus grisea)* and its hybrids to *Q. arizonica*
Emory oak *(Quercus emoryi)*
twoneedle pinyon *(Pinus edulis)* (HSM climates)
Arizona pinyon *(Pinus fallax)* (LSM)
alligator juniper *(Juniperus deppeana)*
oneseed juniper *(Juniperus monosperma)*
Utah juniper *(Juniperus osteosperma)* (usually associated with PIFA phase)
Arizona madrone *(Arbutus arizonica)* (SE Arizona)
Texas madrone *(Arbutus xalapensis)* (S. Guadalupe Mountains, New Mexico)

SHRUBS

Common (>1% cover) to well represented (>5% cover)**:**

skunkbush sumac *(Rhus trilobata)*
sacahuista *(Nolina microcarpa)*
Wright silktassel *(Garrya wrightii)*
hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus)*
desert ceanothus*(Ceanothus greggii)*
common sotol *(Dasylirion wheeleri)*

Schott yucca *(Yucca schottii)*
banana yucca *(Yucca baccata)*
tulip pricklypear *(Opuntia phaeacantha)*
pricklypear cacti (*Opuntia* spp.)
Fendler ceanothus*(Ceanothus fendleri)*
evergreen sumac *(Rhus virens* var.*choriophylla)*
bastardsage *(Eriogonum wrightii)*
Palmer century plant *(Agave palmeri)*

HERBS

Poorly represented (<5% cover); scarce (<1% cover) to common (>1% cover) Texas bluestem *(Schizachyrium cirratum)* [Guadalupe Mountains, NM]
dwarf stickpea *(Calliandra humilis)*
single threeawn *(Aristida orcuttiana)*
Arizona threeawn *(Aristida arizonica)*
threeawns *(Aristida* spp.*)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
bean (*Phaseolus* spp.)
sages (*Artemisia* spp.)

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus = C. breviflorus*)
evergreen sumac *(Rhus virens* var.*choriophylla = Rhus choriophylla)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
Climate Class: HSM (high sun mild)/ LSM (low sun mild) PIFA phase

PHASES

Oneseed juniper (JUMO) phase is the typical phase where twoneedle pinyon and oneseed juniper are codominant. In the alligator juniper (JUDE2) phase, twoneedle pinyon and alligator juniper are codominants. Arizona pinyon is codominant with Utah juniper in the PIFA phase. Further study may classify this woodland in the Guadalupe Mountains as a distinct plant association.

FIRE ECOLOGY

Pavek, 1994 indicates that historically, fires probably occurred about every 10 to 20 years in oak woodlands adjacent to semidesert grasslands; and every 1 to 38 years in the Chiricahua National Monument.

Intense fires, as a disturbance factor, favor oak species. Small Arizona white oak are top-killed by fire. Larger trees usually survive low intensity fires. Its foliage is highly flammable. Fires move quickly through oak woodlands that have a continuous grass understory. Surviving stumps sprout vigorously. Acorns not buried in the soil probably do not survive even low intensity fire.

REFORESTATION

Wood harvesting methods: Partial retention of the overstory, as usually produced by selection and shelterwood harvesting methods, provides microclimates favorable for regeneration of oak. Heavier removal of the overstory as seen in seedtree and clear cutting favors oak and skunkbush sumac.

Planting is not recommended. Mechanical site prep and burning favors oak.

REVEGETATION CONSIDERATIONS

Revegetation is expected to be rapid due to the sprouting of oak.

COMMENTS

MAP = 19"/yr, MAAT = 54 degrees F.

This plant association is productive for deer browse and offers effective hiding cover. Arizona white oak acorns are consumed by cattle and wildlife; its foliage is highly palatable to white-tailed and mule deer in all seasons.

REFERENCE(S)

USFS 1986
USFS 1987b
Pavek, D. S. 1994.

Gray oak/sideoats grama
Quercus grisea/
Bouteloua curtipendula

QUGR3/BOCU

CODE(S)

typic phase 6 30 01 0

KEY CRITERIA

Oak savannas on foothills and canyons with *__gray oak__ and other oaks, pinyons and junipers with a grassy understory.

STRUCTURE

The savanna or open woodland begins with about 5% canopy of combined oak and juniper. At higher elevations, tree coverage can increase to 40-50% and includes mixes of oak, juniper, and pinyon. However, gray oak (as a tree) is always well represented (having >5% cover).

LOCATION

Piedmont hills, canyon bottoms and slopes, and coalescent alluvial fans of shallow, rocky, and erosive soils; at elevations from 5,500' to 6,500' (1,676 to 1,980 m) or to 7,500' (2,286 m) on south to west-facing mountain slopes; southern New Mexico; local in southeastern Arizona.

ADJACENT PLANT ASSOCIATIONS

At lower elevations, QUGR3/BOCU can grade into desert grassland.

ALSO SEE

Dick-Peddie and Moir (1970), Gehlbach 1967. TES mapping units 3828, 4835, 4946, 4969, and 4970 on portions of the Glenwood RD, Gila NF indicated as PIED-JUDE2-QUGR3, PIED-JUDE2-JUMO-JUOS-QUGR3, and PIED-JUDE2-QUGR3-QUHY subseries (USFS 1985), QUAR/MUEM and QUAR/RHTR are also similar. Medina (1987) describes a *Quercus grisea* community type at Ft. Bayard, NM that can perhaps be assigned to QUGR3/BOCU. This complex association needs further study.

TREES

Well represented (>5% cover) on drier sites to luxuriant (>50% cover) in some canyon bottoms**:**

gray oak *(Quercus grisea)*
alligator juniper *(Juniperus deppeana)*
oneseed juniper *(Juniperus monosperma)*
twoneedle pinyon *(Pinus edulis)*
border pinyon pine *(Pinus discolor)*

SHRUBS

Common (>1% cover) to well represented (>5% cover)**:**

hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus)*
shrub live oak *(Quercus turbinella)* and hybrids
gray oak *(Quercus grisea)*
sacahuista *(Nolina microcarpa)*
common sotol *(Dasylirion wheeleri)*
banana yucca *(Yucca baccata)*
Mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
skunkbush sumac *(Rhus trilobata)*
Wright silktassel *(Garrya wrightii)*
tulip pricklypear *(Opuntia phaeacantha)*
banana yucca *(Yucca baccata)*
walkingstick cactus *(Opuntia spinosior)*
turpentine bush *(Ericameria laricifolia)*

Some additional shrubs along washes (Typic Ustifluvents) include:

Apaceplume *(Fallugia paradoxa)*
California brickellbush *(Brickellia californica)*
western white honeysuckle *(Lonicera albiflora)*

HERBS

Well represented (>5% cover) to abundant (>25% cover)**:**
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
blue grama *(Bouteloua gracilis)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
common wolftail *(Lycurus phleoides)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
bottlebrush squirrel tail *(Elymus elymoides)*
White Mountain sedge *(Carex geophila)*
Carruth sagewort *(Artemisia carruthii)*
bracted bedstraw *(Galium microphyllum)*
pineywoods geranium
(Geranium caespitosum)
bean (*Phaseolus* spp.)

BRIEF PLANT ID NOTES

Gray oak is a native small to medium-sized evergreen tree to about 65' (20 m) or a low scrubby shrub. The leaves are thin, firm, elliptic to ovate in shape with few if any teeth; shiny gray-green to blue-green above and pale gray-green, dull with dense stellate hairs; 3/4" to 2" (2 to 5 cm) in length.

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus = C. breviflorus*)
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical) to -1(warm, dry)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

Gray oak is probably top-killed by fire. Survivors having a shrubby growth form may sprout. Acorns on the surface are probably killed by fire, while those buried by soil are likely to be able to survive low intensity fires (Pavek 1994c).

COMMENTS

MAP = 19"/yr, MAAT = 55 degrees F.

REFERENCE(S)

Pavek. 1994c
USFS 1986
USFS 1987b

Gray oak/ true mountain mahogany Quercus grisea/Cercocarpus montanus

QUGR3/CEMO2

CODE(S)

typic phase 6 30 02 0

KEY CRITERIA

Oak chaparrals on foothills and canyons with *__gray oak__ and other evergreen and deciduous shrubs, pinyons and junipers with a shrubby understory.

STRUCTURE

Gray oak is a climax species in evergreen oak and encinal communities.

LOCATION

Ridgetops, summits, and mountain or hillslopes at elevations from 6,000' to 7,000' (1,840 to 2,149); southern New Mexico and southeastern Arizona.

ALSO SEE

Medina (1987), scarp woodland, mapping unit 4910 for TES in Glenwood RD, Gila NF. If twoneedle pinyon has > 1% cover and is regenerating below other trees and shrubs, PIED/CEMO, QUGR3 phase (204032 in USFS 1986a) very similar, but the oak is generally shrubby (not tree-like).

TREES

Well represented (>5% cover)**:**
***gray oak** *(Quercus grisea)*
alligator juniper *(Juniperus deppeana)*
twoneedle pinyon *(Pinus edulis)*
Utah juniper *(Juniperus osteosperma)*
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Abundant (>25% cover) to luxuriant (>50%):
hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus)*
true mountain mahogany *(Cercocarpus montanus*)
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
sacahuista *(Nolina microcarpa)*
Palmer century plant *(Agave palmeri)*
tulip pricklypear *(Opuntia phaeacantha)*
walkingstick cholla *(Opuntia spinosior)*
banana yucca *(Yucca baccata)*

HERBS

Typically scarce (< 1% cover) due to strong tree and shrub dominance**:**
sideoats grama *(Bouteloua curtipendula)*
three awns (*Aristada* spp.)
muttongrass *(Poa fendleriana)*
blue grama *(Bouteloua gracilis)*
Louisiana sagewort *(Artemisia ludoviciana)*
dwarf lousewort *(Pedicularis centranthera)*
and occasional other forbs.

BRIEF PLANT ID NOTES

True mountain mahogany is a small native, evergreen to persistent tree or shrub growing up to 20 feet (6m) tall. Its leaves are simple, alternate, lanceolate to roundish, and 1 to 1.5 inches (2.5 to 4 cm) long. The grayish-green upper surface is glabrous to pilose while the underside is tomentulose and paler in color. The leaf margin is rounded at the apex, coarsely ovate toothed. This shrub is most often a resident of dry hillslopes.

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus var. paucidentatus = C. breviflorus*)

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
(varies from warm, dry to cool moist)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

True mountain mahogany seems to burn less readily than many other shrubs, is damaged usually only temporarily and it sprouts vigorously from the root crown after most fires. [Ream 1964, Lindenmuth and Glendening 1962, Pase and Lindenmuth 1971, Bradley *et al*. 1991, and Crane 1982.]

During presettlement times, fires in open, dry habitats where true mountain mahogany was likely to occur, were probably of low severity because of fuel discontinuity. Today, many formerly open stands are dominated by conifers and decadent shrubs which provide greater fuel loads. When fires occur, they are likely to be more severe—Bradely *et al*. 1991.

COMMENTS

Gray oak is seldom used by cattle or sheep. Goats may consume it with some adverse effects to their digestive system. Various wildlife species use gray oak: spring browse for pronghorn; partial browse diet component for elk, white-tailed deer, and mule deer; mast (acorns) for Merriam's turkey, thick-billed parrot, Viosca's pigeon, and other birds

The shrubby growth form provides cover for small to medium size mammals and birds.

REFERENCE(S)

USFS 1986
USFS 1987b

Emory oak/pointleaf manzanita QUEM/ARPU5
Quercus emoryi/ Arctostaphylos pungens

CODE(S)
typic phase 6 20 01 0

KEY CRITERIA
Oak woodlands having scattered trees (usually low i.e., 8-12 feet tall) with ***Emory oak** attaining < 5% cover; abundant shrub layer with ***pointleaf manzanita** cover exceeding 5%, and herbaceous ground cover usually scarce (<1% cover).

LOCATION
Known from a variety of landforms and mixed parent materials, and soils; at elevations from 4,200' to 5,600' (1,280 to 1,700 m); southwestern New Mexico and southern Arizona; being more common south of the Mogollon Rim in Arizona.

ADJACENT PLANT ASSOCIATIONS
Intergrades to QUEM/DAWH2 and QUAR/MUEM as soils become deeper or less erosional and to PIFA/ARPU5 at higher elevations.

ALSO SEE
On northern portions of the Tonto NF, see map units 3752, 3753, and 4242 of the TES (USFS 1986c); see MU s 4366 and 4439 for the Globe RD (USFS 1984).

TREES
Well represented (>5% cover)**:**
***Emory oak** *(Quercus emoryi)*
Arizona white oak *(Quercus arizonica)*
alligator juniper *(Juniperus deppeana)*
(LSM Climate)
border pinyon *(Pinus discolor)* (HSM climate)
Arizona pinyon *(Pinus fallax)* (LSM climate)
Arizona madrone *(Arbutus arizonica)*
(SE Arizona)

SHRUBS
Abundant (>25% cover)**:**
***pointleaf manzanita**
(Arctostaphylos pungens)
Pringle manzanita *(Arctostaphylos pringlei)*
Wright silktassel *(Garrya wrightii)*
true mountain mahogany
(Cercocarpus montanus)
shrub live oak *(Quercus turbinella)*
skunkbush sumac *(Rhus trilobata)*
mimosa *(Mimosa aculealicarpa*
var. *biuncifera)*
common sotol *(Dasylirion wheeleri)*
[a scattering of]
Palmer century plant *(Agave palmeri)*
Schott yucca *(Yucca schottii)*
banana yucca *(Yucca baccata)*
sacahuista *(Nolina microcarpa)*
tulip pricklypear *(Opuntia phaeacantha)*
hollyleaf buckthorn *(Rhamnus crocea*
var. *ilicifolia)*

HERBS
Scarce (<1% cover) or common (>1% cover)**:**
Texas bluestem *(Schizachyrium cirratum)*
bullgrass *(Muhlenbergia emersleyi)*
single threeawn *(Aristida orcuttiana)*
Arizona threeawn *(Aristida arizonica)*
threeawns *(Aristida* spp.*)*
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
plains lovegrass *(Eragrostis intermedia)*

BRIEF PLANT ID NOTES
Emory oak is a medium-sized native evergreen tree about 50" (15m) tall, but often occurs in shrub form. Its leaves are semi-persistent; broadly lance-shaped, 1" to 2.5" (2.5 to 6 cm) long, with a short spiny tip and a few short spiny teeth. They are thick, stiff, leathery, flat,

shiny dark green above, paler below, and are nearly hairless except for dense hairs at base of midrib below.

Pointleaf manzanita is a bushy, native, short-lived, evergreen broadleaf shrub, approximately 5' to 7' (1.5 to 2 m) tall. Its leaves are oval-shaped with sharp pointed tips, bright green, leathery, and covered with soft, fine hairs. The stems are shiny red.

SYNONYMY

mimosa *(Mimosa aculealicarpa* var. *biuncifera = M. biuncifera)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: varied
Climate Class: HSM (high sun mild)/ LSM (low sun mild)

FIRE ECOLOGY

Emory oak is well adapted to recurrent fire. It is a vigorous sprouter from the root crown or stump following fire (Cable 1979, Carmichael *et al* 1978). Historically, fires probably occurred every 10 to 20 years in oak woodlands (Baisan and Swetnam 1990). The estimated fire regime for the Madrean oak-pine woodland is probably a fire-tolerant, fire-maintained community (Swetnam *et al* 1992). Recent or frequent past fires could reduce the conifers and increase shrub components. Vegetation would resemble chaparral.

Pointleaf manzanita does not sprout from the roots or crown following fire. It is a prolific seeder in response to fire. Such seed crops can be stored in the soil for decades. Pointleaf communities are characteristic of frequently burned areas with dry, coarse soils and are typically found in the transition zone between chaparral and pine or oak woodlands.

REFORESTATION

Wood harvesting methods: Partial retention of the overstory, as usually produced by selection and shelterwood harvesting methods, provides microclimates favorable for regeneration of oak. Heavier removal of the overstory as seen in seedtree and clear cutting favors oak and manzanita.

Planting is not recommended. Mechanical site prep or burning favors oak and manzanita.

REVEGETATION CONSIDERATIONS

Revegetation is expected to be rapid due to the sprouting of oak.

COMMENTS

MAP = 20-22"/yr. May and June are hot and dry.

This plant association is not productive for livestock grazing. Forage value rating (cattle) in early seral stage is low and is none in late seral stage.

REFERENCES

Baisan and Swetnam 1990
Carmichael *et al* 1978
Harris 1988a

Emory oak/sideoats grama
Quercus emoryi/
Bouteloua curtipendula

QUEM/BOCU

CODE(S)

typic phase 6 20 02 0
sacahuista phase 6 20 02 1

KEY CRITERIA

Oak savannas having scattered trees (usually exceeding 12' tall) with ***Emory oak** attaining < 5% cover; with grassy understory on alluvial soils.

STRUCTURE

Emory oak is a climax species in encinal and evergreen oak woodlands and has a seral or climax role in pine-oak woodlands.

LOCATION

Deep, well drained alluvial soils of basin fill, depositional soils of ephemeral streams and washes, piedmont alluvial fans, toeslopes of mixed alluvial-colluvial parent materials, hills, and residual soils of rhyolitic pediments and elevated plains; mostly at elevations from 4,500' to 5,500' (1,370 to 1,670 m); southwestern New Mexico and southeast and south central Arizona; mostly south of the Mogollon Rim in Arizona.

ADJACENT PLANT ASSOCIATIONS

Intergrades to QUAR/PIFI along washes at higher elevations.

ALSO SEE

Bonham 1972, Moir 1979, Wagner 1977; *Quercus emoryi-Nolina microcarpa-Bouteloua curtipendula* h.t. (Willging 1987); both QUAR/MUEM and QUEM/DAWH are also open oak woodland savannas, but these generally occur on colluvial mountain and hill slopes.

TREES & LIFE HISTORY TRAITS

Well represented (>5% cover)**:**
Emory oak *(Quercus emoryi)* C
Arizona white oak *(Quercus arizonica)* C
or hybrids of gray oak *(Q. grisea)*
alligator juniper *(Juniperus deppeana)* c
redberry juniper *(Juniperus erythrocarpa)* c
border pinyon *(Pinus discolor)*
(occasional) c

SHRUBS

Common (>1% cover) in typic phase to well represented (>5% cover) in sacahuista phase**:**
sacahuista *(Nolina microcarpa)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush*(Ericameria laricifolia)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera)*
whitethorn acacia *(Acacia constricta)*
pointleaf manzanita *(Arctostaphylos pungens)*
Wrights buckwheat *(Eriogonum wrightii)*
Schott yucca *(Yucca schottii)*
velvet mesquite *(Prosopis juliflora)*

HERBS

Well represented (> 5% cover) to abundant (>25% cover)**:**
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
blue grama *(Bouteloua gracilis)*
common wolftail *(Lycurus phleoides)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
prairie junegrass *(Koeleria macrantha)*
bean (*Phaseolus* spp.)

ticktrefoil (*Desmodium* spp.)
rose heath *(Chaetopappa ericoides)*
Carruth sagewort *(Artemisia carruthii)*
globemallows (*Sphaeralcea* spp.)

BRIEF PLANT ID NOTES

Sideoats grama is a warm season perennial native grass with scaly rhizomes. The leaf blades are flat, less than 1/4" (3-4 mm) wide, and have short stiff hairs on the surface. The short flower clusters hang mainly from one side of the wavy rachis. Mature leaves take on an orange to purple cast.

SYNONYMY

mimosa *(Mimosa aculealicarpa* var. *biuncifera = M.biuncifera)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

PHASES

There are two phases: the typic phase is more moist and expresses a greater tree/shrub cover. The sacahuista phase is warmer and drier, and expresses greater herbaceous (grassy) cover.

FIRE ECOLOGY

Oak woodlands having a continuous grass understory experience rapidly spreading fires. Fire effects depend on tree size, fire severity, and drought stress.

Small-sized Emory oak may be top-killed by fire. Large trees survive fires of low severity. Well-developed root systems of mature Emory oak buffer the effects of drought and allow rapid regeneration by sprouting vigorously from root crown and stump after top-damage. It recovers quickly from the effects of burning. Unless covered by an insulating layer of soil, acorns are probably killed by fire (Pavek 1994c).

COMMENTS

MAP = 17"/yr.; MAAT = 57 degrees F.; severe drought in May and June.

REFERENCE(S)

Pavek 1994c
USFS 1987b

Emory oak/ common sotol
Quercus emoryi/
Dasylirion wheeleri

QUEM/DAWH2

CODES
typic phase 6 20 03 0

KEY CRITERIA
Oak savannas having scattered trees (usually 10' - 16' tall) with ***Emory oak** attaining < 5 % cover; with grassy understory on colluvial soils (soil materials accumulated through actions of gravity in addition to wind and water).

STRUCTURE
Emory oak is a climax species in encinal and evergreen oak woodlands and has a seral or climax role in pine-oak woodlands.

LOCATION
Mountain and hill slopes, mostly 15-18% on colluvial soils; at elevations from 4,300' to 5,800' (1,300 to 1,760 m); southwestern New Mexico and southeast and south central Arizona; mostly south of the Mogollon Rim in Arizona.

ADJACENT PLANT ASSOCIATIONS
Intergrades to QUAR/PIFI along washes at higher elevations.

ALSO SEE
QUEM/BOCU on generally alluvial soils with greater tree productivity (see TES reports); Wallmo 1955, Wentworth 1981, Shreve 1915; *Quercus emoryi-Pinus discolor/Mimosa biuncifera* community type (Medina 1987).

TREES
Well represented (>5% cover)**:**
***Emory oak** *(Quercus emoryi)*
Arizona white oak *(Quercus arizonica)*
or hybrids of gray oak *(Q. grisea)*
alligator juniper *(Juniperus deppeana)*
border pinyon *(Pinus discolor)* (occasional)

SHRUBS
Common (>1% cover)**:**
sacahuista *(Nolina microcarpa)*
Schott yucca *(Yucca schottii)*
bastardsage *(Eriogonum wrightii)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush*(Ericameria laricifolia)*
mimosa *(Mimosa aculealicarpa*
var. *biuncifera)*
whitethorn acacia *(Acacia constricta)*
pointleaf manzanita
(Arctostaphylos pungens)
common sotol *(Dasylirion wheeleri)*

HERBS
Well represented (> 5% cover) to abundant (>25% cover)**:**
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
blue grama *(Bouteloua gracilis)*
common wolftail *(Lycurus phleoides)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
prairie junegrass *(Koeleria macrantha)*
bean (*Phaseolus* spp.)
ticktrefoil (*Desmodium* spp.)
rose heath *(Chaetopappa ericoides)*
Carruth sagewort *(Artemisia carruthii)*
globemallows (*Sphaeralcea* spp.)

BRIEF PLANT ID NOTES

Common sotol looks similar to its relatives yucca and agave, having leaves concentrated in a basal rosette, with a single flowering stalk extending above. The leaves are narrow (about one inch [2.5 cm] wide) and 3' to 4' (one meter or more) long. They are fiercely armed with stout recurved teeth on the margins.

SYNONYMY

mimosa *(Mimosa aculealicarpa* var. *biuncifera = M. biuncifera)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

Small-sized Emory oak may be top-killed by fire. Large trees survive fires of low severity. Well-developed root systems of mature Emory oak buffer the effects of drought and allow rapid regeneration by sprouting vigorously from root crown and stump after top-damage. It recovers quickly from the effects of burning. Unless covered by an insulating layer of soil, acorns are probably killed by fire (Pavek 1994c).

COMMENTS

MAP = 17"/yr.; MAAT = 56-57 degrees F; about 55% of precipitation occurs from October through March; severe drought in May and June.

REFERENCE(S)

Medina 1987
Pavek 1994c
Shreve 1915
Wallmo 1955
Wentworth 1981
USFS 1987b

Emory oak/Arizona walnut QUEM/JUMA
Quercus emoryi/Juglans major

SYNONYMS
Quercus emoryi/Vitis arizonica
(Willging 1987)

CODE(S)
typic phase 6 20 04 0

KEY CRITERIA
Tall (trees >30' height) oak woodland having ***Emory oak** well represented (>5% cover) on drainage sideslopes and dry terraces along drainages.

STRUCTURE
Emory oak is a climax species in encinal and evergreen oak woodlands and has a seral or climax role in pine-oak woodlands.

LOCATION
Wash margins and upper terraces of intermittent drainages; at elevations from 5,000' to 6,000' (1,520 to 1,850 m); southwestern New Mexico; southeast and south central Arizona; south of the Mogollon Rim in Arizona.

ALSO SEE
Riparian forests. QUEM/JUMA differs from other riparian forests by lacking tall, deciduous trees such as cottonwood and sycamores as well as lacking willows and alders. (Szaro 1989).

TREES
Abundant (> 25% cover) to luxuriant (> 50% cover) **:**
Emory oak *(Quercus emoryi)*
well represented (>5% cover)
Arizona white oak *(Quercus arizonica)*
gray oak *(Quercus grisea)*
***Arizona walnut** *(Juglans major)*
junipers *(Juniperus* spp.*)*
depending on geography
border pinyon *(Pinus discolor)*
twoneedle pinyon *(Pinus edulis)*
Arizona pinyon *(Pinus fallax) (pinyon pines depending on geography)*
netleaf hackberry *(Celtis laevigata* var. *reticulata)*
chokecherrys *(Prunus* spp.)

SHRUBS
Well represented (> 5% cover)**:**
skunkbush sumac *(Rhus trilobata)*
Apacheplume *(Fallugia paradoxa)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera)*
rubber rabbitbrush *(Chrysothamnus nauseosus)*
western white honeysuckle *(Lonicera albiflora)*
eastern poison ivy *(Toxicodendron radicans)*
red barberry *(Mahonia haematocarpa)*
Willcox barberry *(Berberis willcoxii)*
Arizona grape *(Vitis arizonica)*
Virginia creeper *(Parthenosissus quinquefolia* var *quinquefolia)*

HERBS
Abundant (>25% cover)**:**
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
green sprangletop *(Leptochloa dubia)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
bullgrass *(Muhlenbergia emersleyi)*
deergrass *(Muhlenbergia rigens)*
bulb panicgrass *(Panicum bulbosum)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
Texas bluestem *(Schizachyrium cirratum)*
cane bluestem *(Bothriochloa barbinodis* var. *barbinodis)*
Carruth sagewort *(Artemisia carruthii)*

BRIEF PLANT ID NOTES

Arizona walnut is a small to medium tree with pinnately compound leaves and stout branches.

SYNONYMY

netleaf hackberry *(Celtis laevigata* var. *reticulata = Celtis reticulata)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera = M. biuncifera)*
cane bluestem *(Bothriochloa barbinodis* var. *barbinodis= Andropogon barbinodis)*
Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*
Virginia creeper *(Parthenosissus quinquefolia* var *quinquefolia = P. inserta)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typic) may vary from +1 (cool, wet) to -1 (warm, dry)
Climate Class: HSM (high sun mild) and LSM (low sun mild)

REFORESTATION

Wood harvesting methods: Partial retention of the overstory, as usually produced by selection and shelterwood harvesting methods, provides microclimates favorable for regeneration of oak. Heavier removal of the overstory as seen in seedtree and clear cutting favors oak.

Planting is not recommended. Mechanical site prep or prescribed burning tend to favor oak regeneration.

REVEGETATION CONSIDERATIONS

Revegetation is expected to be moderate to rapid due to the sprouting of oak. Walnut management is yet poorly understood.

FIRE ECOLOGY

Small-sized Emory oak may be top-killed by fire. Large trees survive fires of low severity. Well-developed root systems of mature Emory oak buffer the effects of drought and allow rapid regeneration by sprouting vigorously from root crown and stump after top-damage. Unless covered by an insulating layer of soil, acorns are probably killed by fire (Pavek 1994).

COMMENTS

This plant association is productive for livestock grazing. Forage value rating (cattle) in early seral stage is high and is moderate in late seral stage.

Soils may be influenced by overland flow of water but are rarely flooded. Recharge of soil water is by direct precipitation plus some overland flow. Water table, however, is well below rooting depths and is not appreciably elevated by infrequent water drainage in the adjoining channel. Where overland flow produces a greater amount of soil water, the Emory oaks attain great heights (up to 30'-40').

Arizona walnut is a small to medium tree with pinnately compound leaves and stout branches.

Dick-Peddie (1993) considers Juglans major to be an obligate riparian species. Similarly, other ecologists consider Vitis arizonica, an associated vine in this type, as riparian obligate.

Fluventic Ustochrepts and Typic Ustifluvents are common soils (See TES reports and verify on-site soils).

REFERENCE(S)

Dick-Peddie (1993)
Pavek 1994
Szaro (1989)
USFS 1987b

Silverleaf oak/longtongue muhly Quercus hypoleucoides/ Muhlenbergia longiligula

QUHY/MULO

CODE(S)

typic phase 6 50 01 0

KEY CRITERIA

Closed woodlands or woodlands with shrubby understories; with ***silverleaf oak** well represented (>5% cover) and longtongue muhly common (>1% cover). Mature oaks are trees rather than shrubs.

LOCATION

Canyons at elevations from 6,000' to 6,500' (1,830 to 1,980 m) often on Typic Ustifluvents; and mountain slopes to about 7,500' (2,286 m) on a variety of soils on residual or colluvial parent materials; extreme southwestern New Mexico (Animas Mountains) with outliers to Bushy Mountains; and southeastern Arizona.

ADJACENT PLANT ASSOCIATIONS

None listed in research material.

ALSO SEE

TES mapping unit 4970 on the Glenwood RD, Gila NF (USFS 1985); Wagner 1977; Moir and Lukens 1979 (plot F5 at Chiricahua National Monument, AZ); upper encinal of Lowe 1964; PIDI/QUHY is a chaparralic woodland of shallow, rocky soils.

TREES

Luxuriant (>50% cover)**:**
***silverleaf oak** *(Quercus hypoleucoides)*
Arizona white oak *(Quercus arizonica)*
alligator juniper *(Juniperus deppeana)*
border pinyon pine *(Pinus discolor)*
[occasional]
Arizona madrone *(Arbutus arizonica)*

SHRUBS

Well represented (>5% cover)**:**
netleaf oak *(Quercus rugosa)*
sacahuista *(Nolina microcarpa)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush *(Ericameria laricifolia)*
Parry agave *(Agave parryi)*
Gambel oak *(Quercus gambelii)*

HERBS

Usually poorly represented (<5% cover)**:**
longtongue muhly *(Muhlenbergia longiligula)*
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
prairie junegrass *(Koelaria macrantha)*
Arizona wheatgrass *(Elymus arizonicus)*
wooly brome *(Bromus lanatipes)*
fringed brome *(Bromus ciliatus)*
muttongrass *(Poa fendleriana)*
bullgrass *(Muhlenbergia emersleyi)*
[lower elevations]
falsepennyroyal *(Hedeoma hyssopifolia)*
pineywoods geranium
(Geranium caespitosum)
Fendler meadowrue *(Thalictrum fendleri)*

BRIEF PLANT ID NOTES

Longtongue muhly is a large, tufted, native bunchgrass, having long leaf blades (up to 19 inches [50 cm]) which are slightly in-rolled. The membranous ligule is 1/4" to 3/4" (6 to 20 mm) long, has smooth edges (entire margin), and has a sharp (acute) tip.

SYNONYMY

Arizona wheatgrass *(Elymus arizonicus = Andropogon arizonicum)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: +1(cool, wet)
Climate Class: HSM (high sun mild)

FIRE ECOLOGY

QUHY/MULO differs from published descriptions of pine-oak woodland (Marshall 1957, Niering and Lowe 1984, Whittaker and Niering 1965) by absence of taller, emergent pines above the oak-juniper-pinyon canopy level. However, fires within PIPO/QUHY, PILE/QUHY, and PSME/QUHY plant associations can bring about a successional stage resembling QUHY/MULO woodland. Wagner (1977) refers to such a fire in the Animas Mountains, New Mexico.)

COMMENTS

Climatic analysis on the north slopes of the Santa Catalina Mountains, Arizona gives the following gradient (from Unpublished TES notes):

Elevation (Feet):	6,000	6,500
MAP (in/yr):	23.2	25.0
MAST (F):	52	50

REFERENCE(S)

Marshall 1957
Stuever 1995
USFS 1987b
Wagner 1977

Mexican blue oak/mixed grama
Quercus oblongifolia/
Bouteloua (mixed)

QUOB/
mixed Bouteloua

CODES
typic phase 6 10 01 0

KEY CRITERIA
Oak savannas on gentle slopes or deep alluvial soils with Mexican blue oak common (attaining >1% cover).

LOCATION
Alluvial soils of valley plains and coalescent piedmont fans, lower slopes and toeslopes of mixed alluvium-colluvium; at elevations from 4,500' - 5,300' (1,480 - 1,610 m); known from southeastern Arizona in portions of the Coronado National Forest.

ADJACENT PLANT ASSOCIATIONS
Intergrades to QUAR/PIFI along washes at higher elevations.

ALSO SEE
Bonham 1972 (association 5), Niering and Lowe 1984, open encinal in Whittaker and Niering (1968).

TREES
Well represented (>5% cover)**:**
[trees at maturity- 20' - 25' tall]
***Mexican blue oak** *(Quercus oblongifolia)*
Emory oak *(Quercus emoryi)*
Arizona white oak *(Quercus arizonica)*
alligator juniper *(Juniperus deppeana)*
border pinyon *(Pinus discolor)*
(absent to occasional)

SHRUBS
Scarce (<1% cover) to Common (>1% cover)**:**
sacahuista *(Nolina microcarpa)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush *(Ericameria laricifolia)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera)*
whitethorn acacia *(Acacia constricta)*
pointleaf manzanita *(Arctostaphylos pungens)*
bastardsage *(Eriogonum wrightii)*
Schott yucca *(Yucca schottii)*
velvet mesquite *(Prosopis juliflora)*

HERBS
Abundant (>25% cover)**:**
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
sprucetop grama *(Bouteloua chondrosioides)*
black grama *(Bouteloua eriopoda)*
spidergrass *(Aristida ternipes)*
poverty threeawn *(Aristida divaricata)*
plains lovegrass *(Eragrostis intermedia)*
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
cane bluestem *(Bothriochloa barbinodis* var. *barbinodis)*
common wolftail *(Lycurus phleoides)*
birdbill dayflower *(Commelina dianthiafolia)*
morningglory *(Evolvulus* spp.*)*

BRIEF PLANT ID NOTES
Mexican blue oak is a small evergreen tree to 25' (7.6 m) tall. Leaves are oblong, 1" to 2" (2.5 to 5 cm) long, rounded at both ends, or heart shaped at the base; and have smooth (entire) margins, thin, firm, covered with bloom (waxy film) above and are paler beneath (Little 1950).

SYNONYMY

cane bluestem *(Bothriochloa barbinodis* var. *barbinodis= Andropogon barbinodis)*
Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

COMMENTS

MAP = 17 in/yr.; MAAT = 57 degrees F.

REFERENCE(S)

Bonham (1972)
Lowe (1964)
Little 1950
Niering and Lowe (1984)
USFS 1987b
Whittaker and Niering (1968)

Mexican blue oak/common sotol QUOB/DAWH2
Quercus oblongifolia/ Dasylirion wheeleri

CODE(S)
typic phase 6 10 02 0

KEY CRITERIA
Oak savannas usually of moderate to steep colluvial slopes; with ***Mexican blue oak** attaining >1% cover.

LOCATION
Mountain and hill slopes, mostly 15-80% on a variety of colluvial soils; at elevations from 4,300' to 5,800' (1,300 to 1,760 m); southeastern Arizona in portions of the Coronado National Forest.

ADJACENT PLANT ASSOCIATIONS
Intergrades to QUAR/PIFI along washes at higher elevations.

ALSO SEE
Niering and Lowe 1984, Whittaker and Niering 1965.

TREES
Well represented (>5% cover)**:** [trees mostly of low stature (10' -16' tall)]
***Mexican blue oak** *(Quercus oblongifolia)*
Emory oak *(Quercus emoryi)*
alligator juniper *(Juniperus deppeana)* [occasional]

SHRUBS
Common (>1% cover)**:**
sacahuista *(Nolina microcarpa)*
Schott yucca *(Yucca schottii)*
bastardsage *(Eriogonum wrightii)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
turpentine bush*(Ericameria laricifolia)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera)*
whitethorn acacia *(Acacia constricta)*
velvet mesquite *(Prosopis juliflora)*
Palmer agave *(Agave palmeri)*
Schott agave *(Agave schottii)*

HERBS
Well represented (> 5% cover) to abundant (>25% cover)**:**
Texas bluestem *(Schizachyrium cirratum)*
spidergrass *(Aristida ternipes)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
blue grama *(Bouteloua gracilis)*
purple grama *(Bouteloua radicosa)*
black grama *(Bouteloua eriopoda)*
cane bluestem *(Bothriochloa barbinodis* var. *barbinodis)*
and numerous forbs.

BRIEF PLANT ID NOTES
Common sotol looks similar to its relatives yucca and agave, having leaves concentrated in a basal rosette, with a single flowering stalk extending above. These life-forms are collectively referred to as evergreen rosette shrubs. The leaves are narrow (about one inch [2.5 cm] wide) and 3' to 4 (one meter or more) long. They are fiercely armed with stout recurved teeth on the margins.

SYNONYMY
mimosa *(Mimosa aculealicarpa* var. *biuncifera = M. biuncifera)*
cane bluestem *(Bothriochloa barbinodis* var. *barbinodis= Andropogon barbinodis)*
Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

COMMENTS

MAP = 17"/yr.; MAAT = 56-58 degrees F, about 55% of precipitation occurs from October through March; severe drought in May and June. Climatic analysis on the south slopes of the Santa Catalina Mts., Arizona gives the following gradient (from unpublished TES notes)

Elevation (feet):	4,250	4750
MAP (in/yr)	17.2	18.9
MAST	61	59

REFERENCE(S)

Niering and Lowe 1984
Stuever 1995
USFS 1987b
Whittaker and Niering 1965

twoneedle pinyon pine/ sand bluestem
Pinus edulis/Andropogon hallii

PIED/ANHA

CODE(S)
typic phase 2 04 30 0

KEY CRITERIA
The pinyon-juniper overstory occurs on sandy soils. The understory may be grassy and ***sand bluestem** and/or ***sandhill muhly** are common to abundant. Or if the understory is shrubby, a dominant shrub is sand sagebrush.

STRUCTURE
No productivity information is available specifically for this plant association, however limited plant growth can be expected if sandy soils have low moisture holding capacity and limited fertility.

LOCATION
Occurs locally in the landscape in central and northern New Mexico on valley plains with deep, sandy soils. Typical soil is a Typic Ustipsamments.

ALSO SEE
See TES mapping unit 153 (Carson NF, Edwards *et al*. 1987), a sandy woodland environment without sand bluestem, but including sandhill muhly, Indian ricegrass, and sand dropseed.

TREES
Well represented (>5%):
twoneedle pinyon *(Pinus edulis)*
oneseed juniper *(Juniperus monosperma)*

SHRUBS
Often well represented (>5%):
sand sagebrush *(Artemisia filifolia)*
big sagebrush *(Artemisia tridentata)*
[LSC climate]
soaptree yucca *(Yucca elata)*
skunkbush sumac *(Rhus trilobata)*
rabbitbrush *(Chrysothamnus* spp.)

HERBS
Well represented (>5%):
*sand bluestem *(Andropogon hallii)*
*sandhill muhly *(Muhlenbergia pungens)*
little bluestem *(Schizachyrium scoparium)*
blue grama *(Bouteloua gracilis)*
sand dropseed *(Sporobolus cryptandrus)*
spike dropseed *(Sporobolus contractus)*
spreading wallflower *(Erysium repandum)*
Indian ricegrass *(Oryzopsis hymenoides)*

BRIEF PLANT ID NOTES
Similar to big bluestem (considered the same species by some), sand bluestem has two to five finger-like racemes with yellowish hairs on the rachis and pedicels.

SYNONOMY
sand bluestem *(Andropogon hallii = A. gerardii* var. *paucipilus)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: HSC (high sun cold)
LSC (low sun cold)

FIRE ECOLOGY
No fire ecology information specific to this plant association is available. However, warm-season perennial grasses such as sand bluestem are most susceptible to fire during the growing season, and generally recover very rapidly after fires. Where prescribed

burning is considered for unstable sand dune areas, burning may be best in the spring, prior to grass growth, to minimize exposure of bare soils. Unless grasses are abundant, prescribed burning may be difficult due to lack of fine fuels for fire spread.

REFORESTATION

No information available for this plant association. Successful planting of pinyon or juniper may be difficult to achieve due to limited moisture.

REVEGETATION CONSIDERATIONS

Where grasses have been established previously, rhizomes and roots may aid in rapid recovery from surface disturbance such as fire. Due to high erosion potential, reseeding may be necessary for other conditions.

COMMENTS

Where sand bluestem grows in large patches, upland birds and small wildlife find good environmental protection. As a 'decreaser', sand bluestem is an indicator of good range conditions. It's extensive system of roots and rhizomes does a good job of stabilizing sandy soils (Uchytil 1988).

REFERENCE(S)

Edwards *et al*. 1987
Moir & Carleton 1987
Uchytil 1988a
USFS 1987a

twoneedle pinyon pine/manzanita
Pinus edulis/Arctostaphylos pungens

PIED/ARPU5

CODE(S)
typic phase 2 04 40 0

KEY CRITERIA
This plant association exhibits a chaparralic expression of shrubs (i.e. dense shrubs), but relatively minor herbs. ***Pointleaf manzanita** is often well represented or abundant.

STRUCTURE
No information on the productivity of this plant association is available.

LOCATION
Known from Grand Canyon National Park, north of the Colorado River from Shivwits Plateau to Naukoweep Valley. Also on the Globe Ranger District, Tonto National Forest.

ALSO SEE
Pinus fallax/Arctostaphylos pungens has Arizona pinyon as dominant tree, and no big sagebrush; *Pinus edulis-Quercus turbinella-Arctospaphylos pungens association* (Warren *et al*. 1982).

TREES
Well represented (>5%):
twoneedle pinyon *(Pinus edulis)*
Utah juniper *(Juniperus osteosperma)*

SHRUBS
Abundant (>25%):
*pointleaf manzanita
(Arctostaphylos pungens)
shrub live oak *(Quercus turbinella)*
ashy silktassel *(Garrya flavescens)*
big sagebrush *(Artemisia tridentata)*
spiny greasebush *(Glossopetalon spinescens)*
true mountain mahogany
(Cercocarpus montanus)
broom snakeweed *(Gutierrezia sarothae)*
banana yucca *(Yucca baccata)*
skunkbush sumac *(Rhus trilobata)*
Utah agave *(Agave utahensis)*

HERBS
Scarce to common.

BRIEF PLANT ID NOTES
The dark mahogany-colored bark of the manzanita is smooth. The manzanita shrub, which can root from drooping branches and form extensive thickets, has thick, leathery lime-green leaves.

SYNONOMY
spiny greasebush *(Glossopetalon spinescens = G. nevadense)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSC (low sun cold)
LSM (low sun mild)

PHASES
No phases have been identified for this type.

FIRE ECOLOGY
Although no documented information on fire in the plant association is available, fires are probably a major disturbance factor considering the strong expression of manzanita (Harris 1988a).

REFORESTATION
Generally, abundant shrubs may inhibit natural and artificial tree seedlings, however there may be some nurse plant relationships between big sagebrush and pinyon.

REVEGETATION CONSIDERATIONS

Manzanita re-establishes from seed. Shrub live oak and mountain mahoghany often sprout following disturbance.

REFERENCE(S)

Harris 1988a
Moir & Carleton 1987
USFS 1987a
USFS 1987b
Warren *et al*. 1982

twoneedle pinyon pine/ big sagebrush Pinus edulis/Artemisia tridentata

PIED/ARTR2

SYNONYMS

Pinus edulis-Juniperus osteosperma/Artemisia tridentata (Johnston 1987).

CODE(S)

Utah juniper (JUOS) phase	2 04 01 0
oneseed juniper (JUMO) phase	2 04 01 1
Rocky Mountain juniper (JUSC) phase	2 04 01 2

KEY CRITERIA

This plant association has ***big sagebrush** in the understory and a pinyon-juniper overstory.

LOCATION

This plant association is found on highly variable soils and topography from 6,000' to 7,400' (1830-2255 meters). The Utah juniper phase occurs from southwest Colorado and southern Utah into northern Arizona and north-central New Mexico. The oneseed and Rocky Mountain juniper phases occur from north-central New Mexico into southern Colorado. Mean annual precipitation (MAP) about 16"/year (Erdman *et al.* 1969).

ALSO SEE

Erdman (1970); Erdman, Douglas, and Marr (1969); Jameson *et al.* (1962); Schmutz *et al.* (1967); TES mapping units 142, 145, 151, 53, and 194 on Carson National Forest (Edwards 1987); TES mapping units 206, 207, 220, 214, and 643 on Santa Fe National Forest (Gass *et al.* 1981, Gass *et al.* 1983); CW2c; *Juniperus osteosperma-Pinus edulis-Artemisia tridentata* association (Warren *et al.* 1982).

TREES

Well represented (>5%), species of juniper depends on geography & elevation:
twoneedle pinyon *(Pinus edulis)*
oneseed juniper *(Juniperus monosperma)*
lower elevation sites
Utah juniper *(Juniperus osteosperma)*
Rocky mountain juniper *(Juniperus scopulorum)*

SHRUBS

Common to abundant (>1% to >25%):
*big sagebrush *(Artemisia tridentata)*
fourwing saltbush *(Atriplex canescens)*
pale wolfberry *(Lycium pallidum)*
banana yucca *(Yucca baccata)*
rubber rabbitbrush *(Chrysothamnus nauseosus)*
longflower rabbitbrush *(Chrysothamnus depressus)*
Mormon tea *(Ephedra viridis)*
broom snakeweed *(Gutierrezia sarothae)*
Whipple cholla *(Opuntia whipplei)*
plains pricklypear *(Opuntia polyacantha)*

HERBS

Well-represented (>5%), in addition to the list below, annual grasses, particularly from the genus *Bromus,* are common on grazed sites or disturbed soil:
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
bottlebrush squirreltail *(Elymus elymoides)*
needleandthread *(Stipa comata)*
New Mexico needlegrass *(Stipa neomexicana)*
desert needlegrass *(Stipa speciosa)*
Indian ricegrass *(Oryzopsis hymenoides)*
littleseed ricegrass *(Oryzopsis micrantha)*
western wheatgrass *(Pascopyrum smithii)*
ring muhly *(Muhlenbergia torreyi)*

galleta *(Hilaria jamesii)*
blue grama *(Bouteloua gracilis)*
phlox *(Phlox* spp.)

BRIEF PLANT ID NOTES

Recognizing the variety of big sagebrush is important for determining the browse value for elk and deer. Basin big sagebrush *(A. t.* var. *tridentata)* has an uneven top, a single main stem, and gray-green foliage. Mountain big sagebrush *(A. t.* var. *vaseyana)* has a flat top, multiple main stems, and blue green foliage (often described as resembling "a birthday cake with candles sticking up on it"). Wyoming big sagebrush *(A. t.* var. *wyomingensis)* has a round top, multiple main stems and gray-green foliage.

SYNONOMY

bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSC (low sun cold)

PHASES

Phases are distinguished by the dominant juniper (see "Location" for geography). Rocky Mountain juniper (JUOS) phase occurs at higher elevations than the oneseed juniper (JUMO) phase.

FIRE ECOLOGY

Fires are probably infrequent but important to defining the vegetation within this association. Succession is varied, and has been described for Mesa Verde, CO by Erdman (1970). Big sagebrush is easily killed by fire and does not resprout, but rapidly reinvades a site if soil-stored or off-site seed is available (Bradley 1986a, Bunting 1987). Big sagebrush may be greatly reduced when fire return intervals are less than 10 years (Bunting 1987, Everett 1987). Tree recovery appears to be slow following fire, resulting in plant communities dominated by big sagebrush for many decades (Jameson *et al.* 1962, Erdman 1970). Where big sagebrush is limited for winter range, prescribed burning may be detrimental to mule deer populations (Suminski 1993).

REFORESTATION

Pinyon seedlings generally need shade for initial establishment. Natural regeneration may be greater where shrubs are available as nurse plants.

REVEGETATION CONSIDERATIONS

Clary and Wagstaff (1987) compared a variety of techniques for revegetating burns following wildfires in central Utah.

Springfield (1976) suggests that crested wheatgrass can be successfully seeded in this plant association. Other plants also suggested, but with perhaps broader ecological amplitudes, are: western wheatgrass, pubescent wheatgrass, intermediate wheatgrass, blue grama, black grama, sideoats grama, sand dropseed, spike muhly, Indian ricegrass, sweet clover, and four-wing saltbush.

Big sagebrush, a good winter forage plant, can be successfully drilled or broadcast seeded. The "Hobble Creek" selection of mountain big sagebrush is available for lower elevations (Welch *et al.* 1986), and the "Gordon Creek" selection of wyoming big sagebrush is available for higher elevations (Welch *et al.* 1992).

Erdman *et al.* (1969) describes this association on steep, southwest facing slopes at Mesa Verde, and comments that these sites are least favorable for plant growth in that general location.

COMMENTS

Schmutz *et al*. (1967) found twice the diversity of plant species between an isolated not-grazed penisula and the grazed mainland on the north rim of the Grand Canyon.

Determining which variety of big sagebrush is present is important for wildlife management. *A. t.* var. *tridentata* is generally poor browse, although *A. t.* var. *wyomingenis* provides good winter browse for elk and deer and *A. t.* var. *vaseyana* provides good summer browse.

Blaisdell, *et al*. (1982) offers guidelines for assessing range condition and improving forage values on sagebrush and grass ranges, which may also be applicable to this type.

This association can provide critical winter range for elk and deer. Firewood potential is usually good for the JUOS and JUSC phases (Jack Carpenter, pers. comm. 1996). (Edwards *et al*. 1987). (Gass *et al*. 1981, 1983).

REFERENCE(S)

Blaisdell, *et al*. 1982
Bradley 1986
Bunting 1987
Clary and Wagstaff 1987
Donart *et al*. 1978
Edwards *et al*. 1987
Erdman 1970
Erdman, Douglas, and Marr 1969
Everett 1987
Gass *et al*. 1981, 1983
Jameson *et al*. 1962
Johnston 1987
Moir & Carleton 1987
Phillips and Yates 1995
Schmutz *et al*. 1967
Springfield 1976
Suminski 1993
USFS 1987a

twoneedle pinyon pine/blue grama PIED/BOGR2
Pinus edulis/Bouteloua gracilis

SYNONYMS

Pinus edulis-Juniperus monosperma/Bouteloua gracilis (Barnes and Cunningham 1987)

CODE(S)

Utah juniper (JUOS) phase	2 04 02 1
oneseed juniper (JUMO) phase	2 04 02 2
alligator juniper (JUDE2) phase	2 04 02 3
hillslope phase	2 04 02 4

KEY CRITERIA

Understory is essentially grassy with ***blue grama** *(Bouteloua gracilis)* as a dominant grass, and mountain muhly *(Muhlenbergia montana)* is scarce or absent. Generally warm season grasses are more prevalent. Shrubs may be scarce to well-represented, but oaks are not common.

LOCATION

Widespread in New Mexico, Arizona, Colorado and Utah. Occurs in valleys or on elevated plains, piedmont slopes, and mountain slopes. Elevations range from 5100' - 7600' (1550 - 2320 m) depending on aspect and soils. Occurs on a wide variety of soil and parent materials. Mean annual precipitation (MAP) is approx. 15-18"/year.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic), +1 (cool, wet) for JUDE phase
Climate class: HSC (high sun cold) HSM (high sun mild)

TREES

Well represented to abundant (>5% to >25%):
twoneedle pinyon *(Pinus edulis)*
alligator juniper *(Juniperus deppeana)*
Utah juniper *(Juniperus osteosperma)*
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Scarce (<1%) or common (>1%):
skunkbush sumac *(Rhus trilobata)*
true mountain mahogany *(Cercocarpus montanus)*
broom snakeweed *(Gutierrezia sarothrae)*
rabbitbrush *(Chrysothamnus* spp.)
wavyleaf oak *(Quercus* X *pauciloba)*
tree cholla *(Opuntia imbricata)*
plains pricklypear *(Opuntia polyacantha)*
tulip pricklypear *(Opuntia phaeacantha)*
Stansbury cliffrose*(Purshia stansburyiana)* [<1-2% cover]
big sagebrush *(Artemisia tridentata)* [<1% cover]
soaptree yucca *(Yucca elata)*
banana yucca *(Yucca baccata)*
red barberry *(Mahonia haematocarpa)*
pale wolfberry *(Lycium pallidum)*

HERBS

Abundant (>25%), especially grasses:
***blue grama** *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
galleta *(Hilaria jamesii)*
littleseed ricegrass *(Oryzopsis micrantha)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koeleria macrantha)*
bottlebrush squirrel tail *(Elymus elymoides)*
needlegrass *(Stipa* sp.)
ring muhly *(Muhlenbergia torreyi)*
fringed sagewort *(Artemisia frigida)*
common wolfstail *(Lycurus phleoides)*
threeawn *(Aristida* spp.)
little bluestem *(Schizachyrium scoparium)*
western wheatgrass *(Pascopyrum smithii)*

CRYPTOGAMS

The greenish foliose lichen *Xanthoparmelia chlorochroa* can be found on rocks and free living in this plant association. Its abundance can serve as a general indicator of ecological health as per nutrient cycling.

Cryptogamic crusts are important in this association, but may be damaged or absent due to grazing and/or foot traffic. Cryptogamic communities are varied, and may decline as tree canopy cover increases. See Ladyman *et al*. (1993) for a study of two PIPO/BOGR2 sites in north central and west central New Mexico.

BRIEF PLANT ID NOTES

The inflorescence or "flag" can be used to distinguish blue grama from hairy grama *(Bouteloua hirsuta)*. On blue grama, the flag is curved and the terminal awn is shorter than the width of the flag. This awn is longer on hairy grama, which also has straight flags.

SYNONOMY

bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*

PHASES

The hillslope phase occurs on slopes >15%, and grasses may be poorly represented. Otherwise, phases are determined by the species of junipers present (alligator juniper is common= JUDE2 phase; Utah juniper common = JUOS phase, otherwise JUMO phase). The JUDE2 phase is the more mesic of these three phases.

ADJACENT PLANT ASSOCIATIONS

May adjoin PIED/STNED at higher elevations and more mesic sites. At lower elevations and steeper sites, may adjoin PIED/MUPA (Kennedy 1983). The hillslope phase grades into JUMO/BOCU or JUMO/BOGR2 on drier, warmer sites.

ALSO SEE

Pinus edulis-Juniperus monosperma/Bouteloua gracilis and *Pinus edulis-Juniperus deppeana/Bouteloua gracilis* (Kennedy, 1983); Dick-Peddie, *et al*. 1984; Francis 1986; Mapping units 118, 159, and 195 (hillslope phase) of Edwards *et al*. (1987); hillslope phases on the Coyote RD (Santa Fe NF) can be found in TES mapping units 143, 215, and 216 (Gass *et al*. 1983); See Barnes (1987) and Barnes and Cunningham (1987) for comparisons between PIED/BOGR2, PIED/POFE, and JUMO/BOCU near Los Alamos, NM.

PIED/POFE may key to PIED/BOGR2. However mountain muhly is scarce in PIED/BOGR2, and cool season grasses are less frequent.

FIRE ECOLOGY

Fires are probably infrequent, but important in this plant association. Arnold *et al*. (1964) compared two sites near Flagstaff, Arizona; one that did not appear to have experienced any fire in the last 100 years, and one that was burned in 1885 and 1930. On the burned site, blue grama had 35% more cover than the unburned site. Kennedy (1983) found that disturbance, including fire, often resulted in thick, brushy understories of wavyleaf oak *(Quercus* X *pauciloba)* on the Lincoln National Forest in south central New Mexico.

Arnold *et al*. (1964) also outlined secondary succession following a fire to include six stages: 1) bare soil & dead standing trees, 2)

annual plants, 3) annual and perennial plants, 4) perennial plants, grasses, and half shrubs, 5) shrubs and perennial grasses, and 6) a climax woodland. Tress & Klopatek (1987) further develop complex concepts of succession following fires in this plant associaiton.

COMMENTS

For a review of rooting depths in this plant association, see Foxx & Tierney (1987).

REFERENCE(S)

Arnold *et al*. 1964
Barnes 1987
Barnes & Cunningham 1987
Dick-Peddie *et al*. 1984
Edwards *et al*. 1987
Everett and Ward 1984
Foxx & Tierney 1987
Francis 1986
Gass *et al*. 1983
Kennedy 1983
Ladyman *et al*. 1993
Muldavin *et al*. 1997
Moir & Carleton 1987
Tress & Klopatek 1987
USFS 1987a
USFS 1986

twoneedle pinyon pine/ true mountain mahogany Pinus edulis/Cercocarpus montanus

PIED/CEMO2

CODE(S)

wavyleaf oak (QUPA) phase	2 04 03 01
gray oak (QUGR) phase	2 04 03 02
Gambel oak (QUGA) phase	2 04 03 03

KEY CRITERIA

This plant association exhibits a chaparralic expression of shrubs (i.e. dense shrubs), but relatively minor herbs. **True mountain mahogany** is common, often well represented or abundant. Gray oak may be well-represented, but other oaks are poorly represented. Tree cover is generally light to moderate.

STAND STRUCTURE AND PRODUCTIVITY

This association can maintain a high volume of woody mass in shrubs and woodland trees. Medina (1987) suggests that past disturbance greatly influences stand characteristics, and tree species may recover very slowly under highly eroding conditions. One measured site index for pinyon for this association is 25. Where this association occurs on steep, rocky sites, expect slow growth, which is unable to sustain much grazing.

LOCATION

Found from southeastern Arizona and south-central New Mexico, north to southern Colorado. Generally occurs on steep to gentle slopes from 5,200' to 7,600' (1585 - 2315 m). Soils are often Udic or Lithic Ustochrepts, and surface is usually rocky (30-70% surface cover with cobbles). Mean annual precipitation (MAP) = about 18"/year. Mean annual air temperature (MAAT) = 53 degrees Fahrenheit.

ALSO SEE

True mountain mahogany may occur in numerous woodlands, including PIED/QUGA, PIED/QUPA4, PIED/BOGR2, etc., but generally shrubs are not as dense.

Pinus edulis-Juniperus osteosperma/Amelanchier utahensis-Cercocarpus montanus (Johnson 1987). *Pinus edulis-Juniperus monosperma/Cercocarpus montanus-Andropogon gerardi* (Kennedy 1983). TES mapping unit 105 in Cuba and Coyote Ranger Districts, Santa Fe National Forest (Gass *et al*. 1981, Gass *et al*. 1983).

May be very similar to gray oak/true mountain mahogany (QUGR3/CEMO2).

TREES

Well represented (>5%), species of juniper depends on geography & elevation:
twoneedle pinyon *(Pinus edulis)*
alligator juniper *(Juniperus deppeana)*
[not in no. NM]
oneseed juniper *(Juniperus monosperma)*
[lower elevation sites]
Utah juniper *(Juniperus osteosperma)*
Rocky mountain juniper
(Juniperus scopulorum)

SHRUBS

Often abundant (>25%):
*true mountain mahogany
(Cercocarpus montanus)
skunkbush sumac *(Rhus trilobata)*
service berry *(Amelanchier* spp.)
red barberry *(Mahonia haematocarpa)*
wavyleaf oak *(Quercus* X *pauciloba)*
Gambel oak *(Quercus gambelii)*
gray oak *(Quercus grisea)*
cliff fendlerbush *(Fendlera rupicola)*

banana yucca *(Yucca baccata)*
eggleaf silktassel *(Garrya ovata)*
broom snakeweed *(Gutierrezia sarothae)*
sacahuista *(Nolina microcarpa)*
gumhead *(Gymnosperma glutinosum)*
tulip pricklypear *(Opuntia phaeacantha)*

HERBS

Common (>1%) or well-represented (>5%), but much less important than shrubs:
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
little bluestem *(Schizachyrium scoparium)*
big bluestem *(Andropogon gerardii)*
New Mexico muhly *(Muhlenbergia pauciflora)*
common wolfstail *(Lycurus pheloides)*

BRIEF PLANT ID NOTES

Where wavyleaf and Gambel oak ranges overlap, oaks cross easily and are difficult to distinguish by species.

SYNONOMY

wavyleaf oak *(Quercus Xpauciloba = Quercus undulata)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical), +1 (wet, cool)[QUGA phase]
Climate class: LSC (low sun cold)
HSC (high sun cold)
HSM (high sun mild)

PHASES

Phases are distinguished by the dominant oak. If Gambel oak or wavyleaf oak exceed 5% canopy cover, see PIED/QUGA or PIED/QUPA4. PIED/CEMO2 can have over 5% canopy of gray oak, if true mountain mahogany is common.

FIRE ECOLOGY

Expect dense shrubs to establish from root sprouting following fire.

REFORESTATION

Firewood may be reasonable to harvest by a selection method or shelterwood method, but opening the stand through clearcuts or seed tree cuts would result in shrub fields difficult to regenerate in trees.

REVEGETATION CONSIDERATIONS

Natural revegetation is moderately rapid due to resprouting of shrubs.

COMMENTS

Good potential for palatable deer browse. The wavyleaf oak (QUPA4) phase is an excellent winter habitat for deer (USFS 1987b). Hiding cover can be excellent with dense shrubs.

Often, true mountain mahogany is associated with limestone bearing rocks. Planting true mountain mahogany can be done be caching seeds (burying a handful of seeds in one hole). Drilling, where feasible, is also a reasonable way to establish mahogany seedlings. (Suminski, pers. comm. 1996).

REFERENCE(S)

Erdman 1970
Gass *et al*. 1981, 1983
Johnston 1987
Kennedy 1983
Medina 1987
Moir 1963
Moir & Carleton 1987
Muldavin *et al*. 1997
USFS 1987a
USFS 1987b
USFS 1986

twoneedle pinyon pine/ Rabbitbrush-Apacheplume Pinus edulis/Chrysothamnus nauseosus-Fallugia paradoxa

PIED/CHNA2-FAPA

CODE(S)

PIED/CHNA2-FAPA	2 04 33 0
PIFA/CHNA2-FAPA	2 33 33 0
PIDI/CHNA2-FAPA	2 32 33 0

KEY CRITERIA

Rubber rabbitbrush and/or Apacheplume are abundant along washes. Trees present include pinyon and juniper.

STRUCTURE

Disturbances such as periodic flooding, arroyo cutting, and sustained livestock grazing can weaken the tree and perennial grass components and increase the importance of shrubs and annuals. One measured site index for twoneedle pinyon is 25. Several years after disturbance, forage values are generally high due to abundance of palatable shrubs. Stands approaching late succession have low forage values as trees dominate over shrubs.

LOCATION

Widespread geographically, but often occurs very locally in the landscape in intermittent washes and river terraces. Often between 6300' - 7500' (1920 - 2290 m). Common soils include Typic Ustifluvents, Fluventic Haplustolls, and Fluventic Ustocherpts. These are often incised with arroyos or gullies. Also found on deep cindery soils. Site specific determination of soils may be required.

ADJACENT PLANT ASSOCIATIONS

May be adjacent to a wide variety of upland pinyon-juniper plant associations.

ALSO SEE

TES mapping unit 71 for the Carson National Forest (Edwards *et al*. 1987); TES mapping unit 58 for the Apache-Sitgreaves National Forests (USFS 1987). See also Dick-Peddie's arroyo riparian for considering rubber rabbitbrush, Apacheplume, and desert willow as riparian species.

TREES

Common (>1%) or well represented (>5%):
<u>Depending on geography:</u>
twoneedle pinyon *(Pinus edulis)*
Arizona pinyon *(Pinus fallax)*
border pinyon *(Pinus discolor)*
juniper *(Juniperus* spp.)
narrowleaf cottonwood *(Populus angustifolia)* [infrequent & only in some areas]

SHRUBS

Abundant (>25%):
rubber rabbitbrush *(Chrysothamnus nauseosus* var. *graveolens)*
Apacheplume *(Fallugia paradoxa)*
fourwing saltbush *(Atriplex canescens)*
California brickellbush *(Brickellia californica)*
broom snakeweed *(Gutierrezia sarothae)*
<u>depending on geography:</u>
big sagebrush *(Artemisia tridentata)*
desert willow *(Chilopsis linearis)*
skunkbush sumac *(Rhus trilobata)*
red barberry *(Mahonia haematocarpa)*

HERBS

Well represented (>5%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
western wheatgrass *(Pascopyrum smithii)*
numerous other grasses and forbs

BRIEF PLANT ID NOTES

Apacheplume is easy to confuse with cliffrose *(Purshia stansburiana)*, which has sticky leaves and fewer achenes (feathery plumes) per seedhead. Apacheplume is usually in drainages and cliffrose grows on the upland site. For identifying the pinyons, see PIED/sparse.

SYNONYMY

red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:	4 (woodlands)
Elevational Subzone:	0 (typic), +1 (cool, wet)
Climate class:	varies with geography

FIRE ECOLOGY

No specific fire ecology information for this association is available. Fire behavior in this type is probably largely dependent on density of the shrubs. Fires are probably not widespread if stream beds are present to provide fuelbreaks. Rubber rabbitbrush is usually killed by fire, but may sprout if fire intensity was not too hot (Bradley 1986b). Apacheplume resprouts vigorously after a fire (Harris 1988b).

REFORESTATION

For natural regeneration of tree species, wood harvesting should generally be light, either utilizing a shelterwood or selection cutting method. Clearcutting and seed tree cutting are likely to encourage shrubs. Planting trees is not a usual or recommended practice. Mechanical site prep or prescribed burning is likely to encourage rabbitbrush and Apacheplume. No disturbance is more conducive to pinyon pine regeneration.

REVEGETATION CONSIDERATIONS

Natural revegetation following disturbance is usually rapid due to the resprouting of shrubs and grasses.

COMMENTS

Good potential for palatable deer browse if Apacheplume is present.

REFERENCE(S)

Bradley 1986b
Dick-Peddie (1993, p152 ff.)
Harris 1988b
Moir & Carleton 1987
USFS 1987a
USFS 1987b
USFS 1986

twoneedle pinyon pine/blackbrush Pinus edulis/Coleogyne ramosissima

PIED/CORA

CODE(S)

typic phase 2 04 41

KEY CRITERIA

***Blackbrush** is well represented as a shrub. Pinyon and Utah juniper make up the overstory. Grasses and forbs are common.

LOCATION

Known from the Grand Canyon National Park in northern Arizona where it occurs on elevated plains and benches, 3,500' to 6, 200' (1070 - 1890 m). Soils are generally shallow (lithic) and stony and may develop from a wide variety of parent materials.

ALSO SEE

Coleogyne ramosissima-Pinus edulis-Juniperus osteosperma and *Mortonia scabrella-Pinus edulis-Gutierrezia* associations of Warren *et al*. (1982)

TREES

Well represented (>5%):
twoneedle pinyon *(Pinus edulis)*
Utah juniper *(Juniperus osteosperma)*

SHRUBS

Well represented (>5%) to abundant (>25%):
*blackbrush *(Coleogyne ramosissima)*
*Rio Grande saddlebush *(Mortonia sempervirens)*
spiny greasebush *(Glossopetalon spinescens)*
true mountain mahogany *(Cercocarpus montanus)*
shrub live oak *(Quercus turbinella)*
broom snakeweed *(Guiterrizia sarothae)*
fourwing saltbush *(Atriplex canescens)*
Stansbury cliffrose*(Purshia stansburyiana)* [McArthur *et al*. 1983]
turpentinebroom *(Thamnosma montana)*
Utah agave *(Agave utahensis)*
banana yucca *(Yucca baccata)*

HERBS

Common (>1%):
desert needlegrass *(Stipa speciosa)*
bottlebrush squirrel tail *(Elymus elymoides)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
western wheatgrass *(Pascopyrum smithii)*
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
threeawn *(Aristida* spp.)
foxtail brome *(Bromus rubens)*
greenstem paperflower *(Psilotrophe sparsiflora)*

BRIEF PLANT ID NOTES

Blackbrush is a densely branched dark colored shrub with tiny leaves.

SYNONYMY

Rio Grande saddlebush *(Mortonia sempervirens* ssp. *scabrella = M. scabrella)*
spiny greasebush *(Glossopetalon spinescens = G. nevadense)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSC (low sun cold)

FIRE ECOLOGY

Limited information indicates that blackbrush is "almost entirely destroyed by fire".

REFERENCE(S)

McArthur *et al*. 1983
USFS 1987a
Warren *et al*. 1982

twoneedle pinyon pine/ Arizona fescue
Pinus edulis/Festuca arizonica

PIED/FEAR2

CODE(S)
typic phase 2 04 31

KEY CRITERIA
This grassy woodland often has an overstory of tall twoneedle pinyon pine and juniper. ***Arizona fescue *(Festuca arizonica)*** is present, and usually at least common.

STRUCTURE
As with other more mesic plant associations in this series, the potential for high site indices for pinyon is good. The understory is especially luxuriant for a pinyon-juniper type.

LOCATION
Occurs in northern Arizona and west central New Mexico (Mt. Taylor RD, Cibola NF and Quemado RD, Gila NF). Mean annual precipitation (MAP) = 18"/yr.

ALSO SEE
PIED/POFE and PIED/STNED are very similar. For description in Grand Canyon National Park, AZ, see Merkle (1952).

TREES
Abundant (>25%):
twoneedle pinyon *(Pinus edulis)* C
Utah juniper *(Juniperus osteosperma)* c
oneseed juniper *(Juniperus monosperma)* c

SHRUBS
Scarce (<1%):

HERBS
Well represented (>5%), but forbs are minor.:
*Arizona fescue *(Festuca arizonica)*
mountain muhly *(Muhlenbergia montana)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
pine dropseed *(Blepharoneuron tricholepis)*
blue grama *(Bouteloua gracilis)*

BRIEF PLANT ID NOTES
Arizona fescue is a bunchgrass with finely rolled leaves. The seedhead consists of a panicle with flattened spikelets of several flowers.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, wet)
Climate class: mostly LSC (low sun cold)

FIRE ECOLOGY
Low intensity fires may be important for maintaining open stands with grassy understories. However, the grass cover may be more extensive under tree canopies, and sparse in openings which may inhibit the spread of fires. Following harvesting operations, prescribed fire can remove woody material which could otherwise provide shading for pinyon regeneration.

REFORESTATION
Pinyon seedlings need shade to survive. In this association, pinyon seedlings can also face fierce competition from Arizona fescue and other grasses.

COMMENTS
Excessive grazing can stimulate erosion.

REFERENCE(S)
Merkle 1952
Moir & Carleton 1987
USFS 1987a

twoneedle pinyon pine/pine muhly
Pinus edulis/Muhlenbergia dubia

PIED/MUDU

SYNONYMS
Pinus edulis-Juniperus deppeana/Muhlenbergia dubia (Kennedy 1983)

CODE(S)
typic phase 2 04 10

KEY CRITERIA
A savanna (grassy) woodland with an overstory dominanted by alligator juniper and twoneedle pinyon pine. ***Pine muhly** dominates the grass understory, but other grasses are present. There is a sparse shrub understory, primarily of wavyleaf oak.

STRUCTURE
There is very little documented information about this type.

LOCATION
Presently known from the Sacramento and Guadalupe Mountains of southcentral New Mexico where it occurs on moderate slopes of predominately southeastern exposures from 6,000' - 7,300' (1830 -2225 m). Often found on slightly to moderately rocky sites.

ADJACENT PLANT ASSOCIATIONS
This plant association occurs at higher elevations than most of the PIED series. On north-facing slopes, ponderosa pine may be common. It may adjoin with PIED/BOGR2, JUDE2 phase at lower elevations and on flat land forms.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, mesic)
Climate class: HSC (high sun cold)

TREES
Abundant (>25%):
twoneedle pinyon *(Pinus edulis)* C
alligator juniper *(Juniperus deppeana)* S
oneseed juniper *(Juniperus monosperma)* s

SHRUBS
Well represented (>5%):
skunkbush sumac *(Rhus trilobata)*
wavyleaf oak *(Quercus Xpauciloba)*

HERBS
Abundant (>25%):
***pine muhly** *(Muhlenbergia dubia)*
bullgrass *(Muhlenbergia emersleyi)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
little bluestem *(Schizachyrium scoparium)*
manyflowered gromwell *(Lithospermum multiflorum)*
big bluestem *(Andropogon gerardii)*

BRIEF PLANT ID NOTES
Pine muhly is a large, tussock-forming bunchgrass. The rough, green-gray blades are rolled in and have prominent white veins on the upper surface.

SYNONYMY
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*

FIRE ECOLOGY
Fire is probably a major disturbance factor. Recent burns in the Mayhill area may include this plant association.

COMMENTS

In the Guadalupe Mountains of southern New Mexico, Kennedy (1983) reported PIED/MUDU stands that contain madrone *(Arbutus xalapensis)*. She reported that the madrone was endangered from heavy grazing by cattle, and present only in remote, protected sites.

REFERENCE(S)

Kennedy 1983
Moir & Carleton 1987
USFS 1986

twoneedle pinyon pine/ New Mexico muhly Pinus edulis/Muhlenbergia pauciflora

PIED/MUPA2

SYNONYMS

Pinus edulis-Juniperus monosperma/Muhlenbergia pauciflora (Kennedy 1983).

CODE(S)

typic phase 2 04 11

KEY CRITERIA

A savanna (grassy) woodland with an overstory of twoneedle pinyon pine and one-seed juniper. New Mexico muhly is usually part of the grass understory, but not necessarily the dominant grass. This may be one of the drier pinyon/grass plant associations.

STRUCTURE

The crown dominance is usually by oneseed juniper, although twoneedle pinyon may dominate the regeneration. Wavyleaf oak can greatly increase in canopy cover as a response to disturbance, particularly if soil erosion is high.

LOCATION

Presently known from the Sacramento and Capitan Mountains, and White Sands Missile Range, New Mexico. On upper slopes and ridges, gentle to moderate, south-slopes, and on steep north to west slopes. 6,200' - 7,300' (1890 -2225 m).

ADJACENT PLANT ASSOCIATIONS

May adjoin PIED/BOGR2, JUMO phase on more mesic sites.

ALSO SEE

A similar savanna (grassy) woodland is PIED/STNED.

TREES & LIFE HISTORY TRAITS

Well represented to abundant (>5% to >25%):
twoneedle pinyon *(Pinus edulis)* C
oneseed juniper
(Juniperus monosperma) S or C

SHRUBS

Well represented (>5%):
wavyleaf oak *(Quercus Xpauciloba)*
skunkbush sumac *(Rhus trilobata)*
red barberry *(Mahonia haematocarpa)*
true mountain mahogany
(Cercocarpus montanus)

HERBS

Well represented (>5%) to luxuriant:
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
plains lovegrass *(Eragrostis intermedia)*
New Mexico muhly
(Muhlenbergia pauciflora)
common wolfstail *(Lycurus pheloides)*

BRIEF PLANT ID NOTES

New Mexico muhly is a whitish perennial bunchgrass with a firm, knotty base. The branch culms give the bunch a bushy appearance. As with most muhlys, getting familar with the key for this genus is essential for making accurate grass identification.

SYNONOMY

red barberry = algerita *(Mahonia haematocarpa = Berberis haematocarpa)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: HSC (high sun cold)

REFERENCE(S)

Kennedy 1983
Moir & Carleton 1987
Muldavin *et al*. 1997
USFS 1986

twoneedle pinyon pine/Muttongrass PIED/POFE
Pinus edulis/Poa fendleriana

CODE(S)
typic phase 2 04 06

SYNONYMS
Pinus edulis-Juniperus osteosperma/Poa fendleriana (Johnston 1987); *Pinus edulis-Juniperus monosperma/* mixed shrub/*Muhlenbergia montana* (Barnes 1987).

KEY CRITERIA
This woodland often has an overstory of tall twoneedle pinyon pine and juniper, with a grassy understory. ***Muttongrass *(Poa fendleriana)*** is common, but Arizona fescue *(Festuca arizonica)* is absent.

STRUCTURE
This plant association may provide near optimum growing conditions for both pinyon and juniper (Erdman *et al*. 1969). The tallest pinyon trees (35' tall) for the Mesa Verde area were reported in this association.

LOCATION
Occurs in northern Arizona, southern Utah, southern Colorado, and central and northern New Mexico (including the Sandia, Jemez, and Chuska Mountains, and White Sands Missile Range). In the Jemez Mountains, elevations range from 6,500' - 7,100' (1980 -2165 m) on north and east slopes. In the Sandia Mountains, this type can be found up to 8,400' (2560 m) on south-facing slopes. Loamy soils are generally noncalcaeous with high silt and clay content. Mean annual precipitation (MAP) = 18"/yr and mean annual air temperature (MAAT) = 47 deg. F.

ALSO SEE
If Arizona fescue is common, see PIED/FEAR2. If big sagebrush is common, see PIED/ARTR2. PIED/POFE is closely related to PIED/STNED. In Colorado, see Johnston (1987) and Erdman, Douglas, and Marr (1969). In NM, see TES mapping units 194 (Edwards *et al*. 1987), 203, 204 205 (Gass *et al*. 1983) and 78, 208 (Gass *et al*. 1981). For a comparison between PIED/POFE, PIED/BOGR2, and JUMO/BOCU in the Jemez Mountains (Los Alamos), see Barnes (1987).

TREES & LIFE HISTORY TRAITS
Abundant to luxuriant (>25% to >50%):
twoneedle pinyon *(Pinus edulis)* C
Utah juniper *(Juniperus osteosperma)* C
depending on geography:
oneseed juniper *(Juniperus monosperma)* c
Rocky mountain juniper *(Juniperus scopulorum)* c

SHRUBS
Scarce to common (< or > 1%):
narrowleaf yucca *(Yucca angustissima)*
banana yucca *(Yucca baccata)*
plains pricklypear *(Opuntia polyacantha)*
big sagebrush *(Artemisia tridentata)* [<1% cover]
true mountain mahogany *(Cercocarpus montanus)*
Apacheplume *(Fallugia paradoxa)* [granitic soils]

HERBS
Well represented (>5%) to abundant (>25%) especially grasses:
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
mountain muhly *(Muhlenbergia montana)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*

littleseed ricegrass *(Oryzopsis micrantha)*
pine dropseed *(Blepharoneuron tricholepis)*
western wheatgrass *(Pascopyrum smithii)*
blue grama *(Bouteloua gracilis)*
needlegrass *(Stipa* spp.)
Forbs are minor, but can increase on disturbed sites:
Macdougal bluebells *(Mertensia macdougalii)*
Louisiana sagewort *(Artemisia ludoviciana)*
Wright deervetch *(Lotus wrightii)*
phlox *(Phlox* spp.)
Idaho hymenopappus *(Hymenopappus filifolius* var. *lugens)*
Colorado four o'clock *(Mirabelis multiflora)*

BRIEF PLANT ID NOTES

Muttongrass, a perennial bunchgrass, has leaves which are rolled, but can be unfolded to see two lines running up and down the leaf midrib. Muttongrass lacks the cobwebby hairs of Kentucky Bluegrass in the floret, and the spikelets are rounder than Arizona fescue.

SYNONYMY

Fendler threeawn = red threeawn *(Aristida purpurea* var. *longiseta = A. longiseta)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*
Idaho hymenopappus *(Hymenopappus filifolius* var. *lugens = H. lugens)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, wet)
0 (typic)
Climate class: mostly LSC (low sun cold)

FIRE ECOLOGY

Where fire is excluded, the decaying needle layer may inhibit grasses and forbs from growing. With regular fire occurrences (probably on a 15 to 20 year interval), ground cover should be well represented to abundant under trees and sparse to well represented in open spaces (Jack Carpenter, pers. comm. 1996).

COMMENTS

Overgrazed sites of PIED/POFE can lack cool season grasses and may resemble PIED/BOGR2.

REFERENCE(S)

Barnes 1987
Erdman, Douglas, and Marr 1969
Edwards *et al*. 1987
Gass *et al*. 1981, 1983
Johnston 1984
Moir & Carleton 1987
USFS 1987a

twoneedle pinyon pine/ Stansbury cliffrose

PIED/PUST

(Formerly: pinyon pine/cliffrose)

Pinus edulis/Purshia stansburiana

(Formerly: Pinus edulis/Cowania mexicana)

SYNONYMS

Pinyon pine/Cliffrose*(Pinus edulis/Cowania mexicana)* (USFS 1986, 1987a).

CODE(S)

Stansbury cliffrose	
(PUST) phase	2 04 32 0
big sagebrush (ARTR2) phase	2 04 32 1

KEY

CRITERIA

The overstory consists of pinyon pine and Utah juniper and occassionally Gambel oak. The shrubby understory includes ***Stansbury cliffrose.** Antelope bitterbrush and usually mountain mahogany are scarce or absent. Oaks are poorly represented.

LOCATION

Occurs on plains and hillslopes from central Arizona to southern Utah and southwestern Colorado and locally in western New Mexico. General elevation range is 6,000' to 6,800' (1825 - 2075 m). Soils are frequently Lithic Haplustolls or Lithic Ustochrepts on calcareous parent materials. MAP (mean annual precipitation) = 14"-16"/year.

ALSO SEE

Pinyon/blue grama (PIED/BOGR2) if shrubs are poorly represented; Pinyon/Gambel oak (PIED/QUGA) if Gambel oak exceeds 5% cover; mapping unit 52 in Nelson and Redders (1982).

TREES & LIFE HISTORY TRAITS

Well represented (>5%):

twoneedle pinyon *(Pinus edulis)*	C
Utah juniper *(Juniperus osteosperma)*	C

SHRUBS

Well represented (>5%):

Stansbury cliffrose(Purshia stansburiana)*
fernbush *(Chamaebatiaria millefolium)*
Gambel oak *(Quercus gambelii)*
algerita *(Mahonia trifoliata)*
true mountain mahogany *(Cercocarpus montanus)* [usually <1%]
banana yucca *(Yucca baccata)*
big sagebrush *(Artemisia tridentata)* [ARTR phase]
Mormon tea *(Ephedra viridis)*
cholla & pricklypear *(Opuntia* spp.)

HERBS

Well represented (>5%):

blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
needleandthread *(Stipa comata)*
New Mexico needlegrass *(Stipa neomexicana)*
little bluestem *(Schizachyrium scoparium)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
bottlebrush squirreltail *(Elymus elymoides)*
white milkwort *(Polygala alba)*
toadflax penstemon *(Penstemon linarioides)*
fringed sagewort *(Artemisia frigida)*
Louisiana sagewort *(Artemisia ludoviciana)*
drawf stickpea *(Calliandra humilis)*

BRIEF PLANT ID NOTES

Cliffrose can be confused with Apacheplume, but has sticky leaves and fewer achenes per seedhead.

SYNONOMY

Stansbury cliffrose *(Purshia stansburiana = Cowania stansburiana = C. mexicana)*
algerita *(Mahonia trifoliata = Berberis trifoliata)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, mesic)
Climate class: HSM (high sun mild) [PUST phase]
LSC (low sun cold) [ARTR2 phase]

PHASES

In the big sagebrush (ARTR2) phase, big sagebrush and cliffrose are common. This phase occurs in southern UT, CO, and northern AZ and NM where winter moisture exceeds summer moisture.

In the cliffrose (PUST) phase, big sagebrush is usually absent and cliffrose is present. This phase generally occurs further south where summer moisture exceeds winter moisture.

FIRE ECOLOGY

Research literature indicates that Stansbury cliffrose is usually killed by fire (Howard and Holifred 1995). The sprouting ability of cliffrose is variable. Prescribed burning or wildfires in this type can be detrimental for mule deer winter range by reducing cliffrose and big sagebrush which do not survive or respond well to fires, but are critical browse plants (Suminski 1993).

REVEGETATION CONSIDERATIONS

Stansbury cliffrose can be established on disturbed seedbeds by broadcast seeding, drilled seeding and transplants (Howard and Holifred 1995).

COMMENTS

Stansbury cliffrose can withstand moderate browsing, and is considered to provide good forage and cover for mule deer and other wildlife.

REFERENCE(S)

Howard and Holifred 1995
Johnston 1987
Moir & Carleton 1987
Suminski 1993
USFS 1987a
USFS 1986

twoneedle pinyon pine/ antelope bitterbrush Pinus edulis/Purshia tridentata

PIED/PUTR2

SYNONYMS

Pinus edulis-Juniperus osteosperma/Purshia tridentata (Johnston 1987).

CODE(S)

typic phase 2 04 05 0

KEY CRITERIA

The overstory consists of pinyon pine, Utah juniper and occasionally Gambel oak. The shrubby understory includes ***antelope bitterbrush.** Big sagebrush is scarce or absent. Usually has a very sparse cover of grasses and forbs.

STRUCTURE

As with other more mesic plant associations in this series, the potential for high site indices for pinyon is good.

LOCATION

Known from northwestern New Mexico and southwestern Colorado where it occurs on mesa and scarps, 6,900' - 7,500' (2100 -2290 m). Soils are fine sandy loams to sandy loams, with shales and sandstones as parent rock. This plant association is often associated with the "San Jose Formation". Annual precipitation 9-14"/year.

ADJACENT PLANT ASSOCIATIONS

PIED/PUTR2 on steep mesa scarps intergrades to scarp woodland.

ALSO SEE

Twoneedle pinyon/big sagebrush *(Pinus edulis/Artemisia tridentata)* if big sagebrush is well represented; Erdman, Douglas, and Marr (1969). TES mapping unit 769 in Jicarilla Ranger District, Carson National Forest (Edwards *et al.* 1987).

TREES & LIFE HISTORY TRAITS

Well represented (>5%) or abundant (>25%):

twoneedle pinyon *(Pinus edulis)* C
Utah juniper *(Juniperus osteosperma)* C
Gambel oak *(Quercus gambelii)* s

SHRUBS

Well represented (>5%):
*antelope bitterbrush *(Purshia tridentata)*
Utah service berry *(Amelanchier utahensis)*
banana yucca *(Yucca baccata)*
wax currant *(Ribes cereum)*
true mountain mahogany *(Cercocarpus montanus)*
big sagebrush *(Artemisia tridentata)* [<1% cover]
Mormon tea *(Ephedra viridis)*

HERBS

Scarce (<1%) or common (>1%):
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
Ross sedge *(Carex rossii)*
littleseed ricegrass *(Oryzopsis micrantha)*
James buckwheat *(Eriogonum jamesii)*
phlox *(Phlox* spp.)

BRIEF PLANT ID NOTES

Antelope bitterbrush is a low, many-branched, spreading shrub with small, three-tipped, wedge-shaped leaves.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (wet, cool)
Climate class: LSC

FIRE ECOLOGY

Bunting (1987) reports that antelope bitterbrush has limited resprouting capabilities and appears dependent on rodent caching for reestablishment. Bradley (1986c) considers sprouting a major regeneration strategy, particularly for shrubs with a decumbent growth form. Bitterbrush may take up to 20 years to become re-established after a fire (Bunting 1987). Eventually, antelope bitterbrush dominates root sprouting species if fire return intervals are greater than 10-15 years, but it appears to decline 50-100 years after establishment (Everett 1987).

REFORESTATION

Pinyon seedlings generally need shade for initial establishment. Natural regeneration may be greater where shrubs are available as nurse plants.

REVEGETATION CONSIDERATIONS

Bitterbrush seed or seedling stock should be chosen carefully for compatibility with site and purpose as there is wide variability in different accessions (Bradley 1986c).

COMMENTS

This plant association is important winter range for deer and elk. Bitterbrush is often considered good browse forage for cattle, sheep, horses, pronghorn, elk and mule deer (Bradley 1986c). Wildfires or prescribed burning can be detrimental to browse availability (Suminski 1993). Where sandstone rock outcrops occur frequently, management activities such as road construction or revegetation may be limited (Edwards *et al*. 1987).

REFERENCE(S)

Bradley 1986c
Bunting 1987
Edwards *et al*. 1987
Erdman, Douglas, & Marr 1969
Everett 1987
Johnston 1987
Moir & Carleton 1987
Suminski 1993
USFS 1987a

twoneedle pinyon pine/Gambel oak PIED/QUGA
Pinus edulis/Quercus gambelii

CODE(S)
typic phase 2 04 04

KEY CRITERIA
Must have at least 5% cover of ***Gambel oak.** Ponderosa pine may be accidental.

STRUCTURE
This woodland can form a closed canopy (luxuriant tree cover) in prolonged cessation of disturbances such as fire (postclimax).

LOCATION
Local in southern New Mexico, becoming more widespread in central and northern New Mexico, and north of the Mogollon Rim in Arizona. Usually occurs on moderate and steep mountain slopes, 6,300' -8,000' (1920 -2400 m) on cool, wet sites such as draws of north slopes. Mean annual precipitation (MAP) is about 18 in/yr. Mean annual temperature is about 48 deg. F.

ALSO SEE
TES mapping units 119, 140, 157, and 195 in Carson NF (Edwards *et al*. 1987); also Johnston (1984) in CO and Warren *et al*. (1982) *Pinus edulis-Amelanchier utahensis-Quercus gambelii* association in Grand Canyon National Park; *Pinus edulis-Juniperus deppeana-Juniperus monosperma-Quercus gambelii* subseries in Dancker (1985).

TREES & LIFE HISTORY TRAITS
Abundant (>25%):
twoneedle pinyon *(Pinus edulis)* C
Gambel oak *(Quercus gambelii)* S
Rocky Mountain juniper *(Juniperus scopulorum)* c
oneseed juniper *(Juniperus monosperma)* s

SHRUBS
Well represented (>5%):
Gambel oak *(Quercus gambellii)*
whortleleaf snowberry *(Symphoricarpos oreophillus)*
true mountain mahogany *(Cercocarpus montanus),*
wavyleaf oak *(Quercus* X *pauciloba)*
cliff fendlerbush *(Fendlera rupicola)*
plums *(Prunus* spp.)
wild rose *(Rosa* spp.)
big sagebrush *(Artemisia tridentata)* [n. NM]
Utah service berry *(Amelanchier utahensis)* [n. NM]
banana yucca *(Yucca baccata)*
common hoptree *(Ptelea trifoliata)* [s. NM]

HERBS
Common (>1%) or well represented (>5%):
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
mountain muhly *(Muhlenbergia montana)*
Ross sedge *(Carex rossii)*
bottlebrush squirrel tail *(Elymus elymoides)*
blue grama *(Bouteloua gracilis)*
pineywoods geranium *(Geranium caespitosum)*
American vetch *(Vicia americana)*
common yarrow *(Achillea millefolium)*
New Mexico groundsel *(Senecio neomexicanus)*
Fendler meadowrue *(Thalictrum fendleri)*

CRYPTOGAMS
The greenish foliose lichen *Xanthoparmelia chlorochroa* is common in this plant association. Its abundance is generally proportional to healthy nutrient cyling (Sharnof, 1995, pers. comm. w/ Rita Suminski). Other lichen species have also been identified in this plant association, including an orange lichen, *Xanthoria fallax,* which is found on oak bark (Suminski, 1996, pers. comm.).

BRIEF PLANT ID NOTES

Gambel oak is a deciduous oak with deeply lobed, prickle "free" leaves. At lower elevations, it may cross with other oaks, making definitive identification difficult.

SYNONYMY

wavyleaf oak *(Quercus* X *pauciloba = Quercus undulata)*

bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)

Elevational Subzone: +1 (cool, wet)

Climate class: low sun cold (LSC), high sun cold (HSC)

FIRE ECOLOGY

Following a single fire, Gambel oak forms dense thickets by extensive root sprouting. Repeated, relatively high severity fires may reduce Gambel oak (Tirmenstein 1988b). Erdman (1970) noted that at Mesa Verde, CO, in addition to prolific shrub sprouting, two annuals, sunflower *(Helianthus annus)* and pigweed *(Chenopodium pratericola)*, dominated the site during the first two post-fire years.

REFORESTATION

Erdman (1970) reported poor results from pinyon seeding and planting following a summer wildfire at Mesa Verde, in southern Colorado. Of 240,000 seedlings planted in the 1940's, only a few stands of pinyon were present in the late 1960's. Likewise, a seeding project on a 1959 burn in the same area had poor results. Pinyon seedlings need shade to survive, and can persist in the 'grass' stage for 5+ years.

REVEGETATION CONSIDERATIONS

Natural revegetation is rapid due to oak regeneration.

COMMENTS

Phillips and Yates (1995) describe in detail an ecosystem management project in this association on the Santa Fe National Forest that involves firewood harvest, heritage site protection, watershed objectives in an integrated, community based approach.

REFERENCE(S)

Edwards *et al*. 1987
Erdman 1970
Johnston 1987
Muldavin *et al*. 1997
Phillips & Yates 1995
USFS 1987a
USFS 1986

twoneedle pinyon pine/ wavyleaf oak
Pinus edulis/Quercus X pauciloba

PIED/QUPA4

(Formerly: Pinus edulis/Quercus undulata)

CODE(S)

typic phase 2 04 36 0

SYNONYMS

Pinus edulis/Quercus undulata (USFS 1986, USFS 1987a)

KEY CRITERIA

***Wavyleaf oak** is generally abundant (>25%). Pinyon is in the tallest stratum. Herbs are usually poorly represented.

STRUCTURE

This association may be a community type for plant associations that have undergone severe disturbance from fire, mining, overgrazing or other erosion-inducing activity (Kennedy 1983). Pieper & Lymbery (1987) observed highest densities of wavyleaf oak on slopes greater than 20%.

LOCATION

Found in southern (Sacramento Mountains, Lincoln NF and Mescalero Apache Reservation), central New Mexico, and locally in northern New Mexico (including northeastern mesas); 6,000'-8,000' (1,830-2,440 m) on moderate to steep mountain slopes, often on lithic skeletal soils.

ALSO SEE

PIED/MUDU, PIED/STCO3, and PIED/MUPA2 all contain wavyleaf oak, but this oak seldom exceeds 15% cover in mature stands. Wavyleaf oak is a vigorous sprouter after fire or clearing, and early successional stages of these different plant associations may be difficult to separate. See Naumann's (1987) *Pinus edulis-Juniperus monosperma/Quercus undulata, Schizachyrium scoparium* phase.

TREES

Well represented (>5%) or abundant (>25%):
twoneedle pinyon *(Pinus edulis)*
alligator juniper *(Juniperus deppeana)* [not in no. NM]
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Abundant (>25%):
wavyleaf oak *(Quercus* X *pauciloba)
red barberry *(Mahonia haematocarpa)*
cliff fendlerbush *(Fendlera rupicola)*
Wright silktassel *(Garrya wrightii)*
eggleaf silktassel *(Garrya ovata)*
skunkbush sumac *(Rhus trilobata)*
true mountain mahogany *(Cercocarpus montanus)*
banana yucca *(Yucca baccata)*
plums *(Prunus* spp.)

HERBS

Common (>1%):
Numerous species of grasses and forbs, but none are more than 5% cover.

BRIEF PLANT ID NOTES

Where wavyleaf and Gambel oak ranges overlap, oaks cross easily and are difficult to distinguish by species.

SYNONOMY

wavyleaf oak *(Quercus* X*pauciloba = Quercus undulata)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSC (low sun cold)
HSC (high sun cold)
HSM (high sun mild)

FIRE ECOLOGY

With ample fuel ladders from oak understory, expect high fire intensity under dry conditions. Oak quickly resprouts following fires.

REFORESTATION

Planting opportunity may be limited by shallow soils. Pinyon seedlings should be planted in shady microsites.

REVEGETATION CONSIDERATIONS

Natural revegetation is rapid due to oak sprouting.

COMMENTS

Livestock grazing in this association can be hampered by lack of surface water, impenetrable oak thickets, and typically low forage production. Naumann (1987) reported heavy soil erosion in this association on relatively undisturbed sites where surface runoff from bare rock occassionally washed out large amounts of soil.

REFERENCE(S)

Kennedy 1983
Muldavin *et al*. 1997
Naumann 1987
Pieper & Lymbery 1987
USFS 1987a
USFS 1986

twoneedle pinyon pine/rockland Pinus edulis/rockland

PIED/rockland

SYNONYMS

Pinus edulis-Juniperus monosperma /rockland (USFS 1986).

CODE(S)

typic phase 2 04 35 0

KEY CRITERIA

Pinyon trees growing on rock with very little soil.

STRUCTURE

Tree roots often grow in cracks and fissures. Trees may be stunted where moisture is limited. Stocking is often light. Wood production is typically very low.

LOCATION

Scattered locations throughout New Mexico and Arizona, including the malpais area near the Zuni Mountains, NM and the Peloncillo Mountains of southwestern New Mexico. Occurs on lava flows (malpais) or soils that are <4" to bedrock.

ADJACENT PLANT ASSOCIATIONS

May adjoin ponderosa pine/rockland plant association on more mesic, but still rock-dominated sites. Lindsey (1951) reported the Pinyon/rockland to be an ecotone between ponderosa pine and apacheplume dominated plant communities.

ALSO SEE

Lindsey (1951); Moir (1979); *Pinus edulis-Juniperus osteosperma-Quercus turbinella-Cercocarpus intricatus* association in Grand Canyon NP (Warren *et al*. 1982).

TREES

Well represented (>5%), often rooted in fissures:
twoneedle pinyon *(Pinus edulis)*
alligator juniper *(Juniperus deppeana)*
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Common (>1%) to well represented (>5%):
Apacheplume *(Fallugia paradoxa)*
fourwing saltbush *(Atriplex canescens)*
cholla or pricklypear*(Opuntia* spp.)
skunkbush sumac *(Rhus trilobata)*
Mormon tea *(Ephedra viridis)*
shrub live oak *(Quercus turbinella)*
spiny greasebush *(Glossopetalon spinescens)* [in Arizona]

HERBS

Scarce or common. Composition is highly variable.

CRYPTOGAMS

Lindsey (1951) reported the densest lichen growth on rocks in the P-J type of the Malpais near Grants, New Mexico as compared with other life zones.

SYNONYMY

spiny greasebush *(Glossopetalon spinescens = G. nevadense)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (Woodlands)
Elevational Subzone: 0 (typic)
Climate class: varies

FIRE ECOLOGY

Many sites may be protected from frequent fire regimes, although fires are rather common in areas such as the malpais.

REFORESTATION

Natural regeneration is spotty and hard to predict. Artificial regeneration is usually impractical due to the absence of plantable sites.

REVEGETATION CONSIDERATIONS

Revegetation may be slow and spotty.

COMMENTS

Water in ice caves and sinks may provide for diverse wildlife populations in this plant association, particularly in the malpais.

REFERENCE(S)

Lindsey 1951
Moir 1979
USFS 1987a
USFS 1986
Warren *et al*. 1982

twoneedle pinyon pine/sparse c.t. PIED/sparse
Pinus edulis/sparse

SYNONYMS
If Arizona pinyon is dominant, then: Arizona pinyon *(Pinus fallax)*/sparse (PIFA/sparse). If border pinyon is dominant, then: border pinyon *(Pinus discolor)*/sparse (PIDI/sparse).

CODE(S)
typic phase 2 04 50 0

KEY CRITERIA
Understory is sparse, although annual plants may be well represented. Tree cover of pinyon and juniper is usually dense, often forming a closed canopy.

STRUCTURE
Kennedy (1983) noted a well developed litter layer and considered these sites to occur with more mesic conditions, perhaps necessary to support the closed tree canopy. Decreases in site productivity can be expected with extended exposure to wind and water erosion (Baker *et al*. 1995).

LOCATION
Widespread geographically, but often occurs locally in the landscape (i.e. not usually extensive). Often between 6,500' - 7,300' (1980 - 2225 m) on basaltic mesas or hillslopes; soils are widely variable.

ALSO SEE
PIED/Rockland. Arnold, Jameson, and Reid (1964); Dalen and Snyder (1986); and on soils derived from sandstone and gypsum, see TES mapping unit 106 (Santa Fe NF, Gass *et al*. 1981, Price 1983).

TREES
Abundant (>25%):
Depending on geography:
twoneedle pinyon *(Pinus edulis)*
Arizona pinyon *(Pinus fallax)*
border pinyon *(Pinus discolor)*
Utah juniper *(Juniperus osteosperma)*
alligator juniper *(Juniperus deppeana)*
oneseed juniper *(Juniperus monosperma)*
redberry juniper *(Juniperus erythrocarpa)*

SHRUBS
Scarce (<1%) or common (>1%):
skunkbush sumac *(Rhus trilobata)*
cholla or pricklypear*(Opuntia* spp.)

HERBS
Perennial herbs are scarce, annuals may be common to well represented or even abundant.

BRIEF PLANT ID NOTES
The easiest way to distinguish the three pinyons in this region is by counting the number of needles per fascicle (the sheath at the base of the needles). Twoneedle pinyon *(Pinus edulis)*, commonly called Rocky Mountain pinyon has two needles/fascicle; border pinyon *(Pinus discolor)* has three needles/fascicle; Arizona pinyon *(Pinus fallax)* usually has one needle/fascicle, but occasionally has two, with ones and twos on the same tree.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: varies

FIRE ECOLOGY

The closed-canopy, sparse understory conditions may be a relict of extended fire exclusion. These stands generally only burn under extreme fire conditions, and then fire intensity is high, increasing mortality among the already sparse understory. These sites are more susceptible to establishment of annuals like cheatgrass *(Bromus tectorum)* [Bunting 1987].

REFORESTATION

Pinyon are most often naturally re-established from seed stored in caches by birds and small mammals.

REVEGETATION CONSIDERATIONS

Artificial seeding may be necessary to re-establish understory species where sparse understory conditions have persisted, reducing naturally available seed sources.

COMMENTS

This community type is derived from woodlands with a history of livestock grazing, soil erosion and fire cessation. It may be a derived successional stage (disclimax) from several plant associations, as well as a prolonged successional stage (disclimax) under current soil and management conditions. Erosional "badlands" represent PIED/sparse as a natural plant association.

REFERENCE(S)

Bunting 1987
Kennedy 1983
McMurray 1986b
USFS 1987a
USFS 1987b
USFS 1986

twoneedle pinyon pine/ Dore needlegrass

PIED/STNED

(Formerly: pinyon pine/western needlegrass)

Pinus edulis/Stipa nelsoni var. dorei

(Formerly: Pinus edulis/Stipa columbiana)

SYNONYMS

Pinus edulis-Juniperus monosperma/Stipa columbiana (Kennedy 1983).

CODE(S)

typic phase 2 04 37 0

KEY CRITERIA

Pinyon dominates the overstory and grasses dominant the understory. Arizona fescue is absent. Dore needlegrass or Schribner needlegrass are common to well represented. Alligator juniper may be accidental. A distinct litter layer is also usually present.

STRUCTURE

Although junipers can dominate the canopy in early succession, pinyon trees are conspicuously dominant in late successional stands. The site quality for pinyon appears to be good (Kennedy 1983).

LOCATION

Known from the Sacramento Mountains, Jicarilla Mountains, and White Sands Missile Range, and Rowe Mesa (Pecos Ranger District, Santa Fe NF). Occurs on moderate to gentle slopes, 6,200' to 7,300' (1890 - 2225 m). Generally not found on rocky sites.

ADJACENT PLANT ASSOCIATIONS

On drier sites, may adjoin PIED/BOGR2, JUMO phase.

ALSO SEE

PIED/MUPA2 and PIED/STNED are very similar and may be related successionally (see Kennedy 1983).

TREES & LIFE HISTORY TRAITS

Well represented to abundant (>5% to >25%):
twoneedle pinyon *(Pinus edulis)* C
oneseed juniper *(Juniperus monosperma)* S

SHRUBS

Scarce to common (< or > 1%):
wavyleaf oak *(Quercus Xpauciloba)*
skunkbush sumac *(Rhus trilobata)*

HERBS

Well represented (>5%) to abundant (>25%) especially grasses:
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
mountain muhly *(Muhlenbergia montana)*
Dore spear grass *(Stipa nelsonii* spp. *dorei)*
Schribner needlegrass *(Stipa schribneri)*
bottlebrush squirrel tail *(Elymus elymoides)*
little bluestem *(Schizachyrium scoparium)*
littleseed ricegrass *(Oryzopsis micrantha)*
big bluestem *(Andropogon gerardii)*
manyflowered gromwell *(Lithospermum multiflorum)*

BRIEF PLANT ID NOTES

The moderately tall (1-3') culms of Dore needlegrass, also known as Columbia needlegrass, are stout with only a few culms per tuft. Leaves are flat when green and rolled when mature. As with most grasses, specific grass keys should be used to identify grass species.

SYNONOMY

Dore needlegrass *(Stipa nelsonii* spp. *dorei)* = western needlegrass *(Stipa columbiana)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: HSC (high sun cold)

FIRE ECOLOGY

Relatively frequent, light surface fires may maintain the needlegrass understory (Kennedy 1983). Where grasses are abundant, fine fuels are capable of supporting rapid fire spread. Dore needlegrass is generally more resistant to fires than other needlegrasses *(Stipa),* and may be only slightly or moderately damaged by fire. Midsummer fires may be more damaging to the needlegrass in the understory than early spring or late fall fires. Recovery of the needlegrass following a burn may be slow, up to 3-5 years. (Tirmenstein 1987c). Annual grasses may also dominate following burns (Arnold *et. al.* 1964).

REFORESTATION

Provide shading for pinyon seedlings.

REFERENCE(S)

Arnold *et. al.* 1964
Barnes 1987
Erdman, Douglas, and Marr 1969
Edwards *et al.* 1987
Gass *et al.* 1981, 1983
Johnston 1987
Kennedy 1983
Tirmenstein 1987c
USFS 1987a

Arizona pinyon pine/manzanita
Pinus fallax/Arctostaphylos pungens

PIFA/ARPU5

SYNONYMS

Pinus monophylla/Quercus turbinella-Arctostaphylos pungens (Moir & Carleton 1987); expect this to change to *Pinus californiarum* var. *fallax/Arctostaphylos pungens* (PICAF/ARPU5).

CODE(S)

typic phase 2 33 01 0

KEY CRITERIA

This central Arizona plant association exhibits a chaparralic expression of shrubs (i.e. dense shrubs), but relatively minor herbs. ***Pointleaf manzanita** and shrub live oak are at least common, often well represented or abundant. Crucifixion thorn is absent.

STRUCTURE

One site index for Arizona pinyon measured in this p.a. was 25. Cattle forage rating value is moderate for early seral conditions, to none for late seral conditions.

LOCATION

Known from central Arizona below the Mogollon Rim, north in Oak Creek Canyon to Sedona. Elevations are mostly between 4,800' - 6,000' (1,470 - 1,830 m) on a wide variety of slopes, aspects, landforms, and soils. Mean annual precipitation (MAP) = 20"/yr; with a hot, dry season during May and June.

ADJACENT PLANT ASSOCIATIONS

Warmer, drier sites may feature PIFA/QUTU2 (manzanita scarce or absent), juniper woodlands, or chaparral. Colder or wetter sites may have ponderosa pine or Arizona cypress plant associations.

ALSO SEE

PIED/ARPU5 is similar and may occur in southern portions of the Gila, Apache-Sitgreaves, and Coconino National Forests. TES subseries PIMO/JUOS/QUTU2/ARPU5 on the northern portion of Tonto NF (USFS 1986); the modal mapping unit (MU) is MU 3730 (erosional soils on diabase). Other MU's include 3731, 3710 (Typic Haplustalfs, deep gravelly loam, 15-40% slopes), 3752 and 3753 (Typic Ustochrepts), very deep gravelly loams on mixed parent materials and granitics). This subseries was also described in the TES report for Globe RD, MU's 3705, 3765, 4038, 4768, and 4820.

TREES

Well represented (>5%) or abundant (>25%):
Arizona pinyon *(Pinus fallax)*
Utah juniper *(Juniperus osteosperma)*
alligator juniper *(Juniperus deppeana)*
Emory oak *(Quercus emoryi)*
[<5% cover when present]

SHRUBS

Abundant (>25%) or luxuriant (>50%):
***pointleaf manzanita** *(Arctostaphylos pungens)*
shrub live oak *(Quercus turbinella)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
sacahuista *(Nolina microcarpa)*
skunkbush sumac *(Rhus trilobata)*
sugar sumac *(Rhus ovata)*
Wright silktassel *(Garrya wrightii)*
ashy silktassel *(Garrya flavescens)*
red barberry *(Mahonia haematocarpa)*
rough mendora *(Mendora scabra)*
desert ceanothus*(Ceanothus greggii)*
Stansbury cliffrose*(Purshia stansburyiana)*
[calcareous soils]
true mountain mahogany *(Cercocarpus montanus)*
broom snakeweed *(Gutierrezia sarothae)*

HERBS

Scarce to well represented (<1 to >5% cover):
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
curlymesquite *(Hilaria belangeri)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
New Mexico needlegrass *(Stipa neomexicana)*
desert needlegrass *(Stipa speciosa)*
Indian ricegrass *(Oryzopsis hymenoides)*
bottlebrush squirrel tail *(Elymus elymoides)*
plains blackfoot *(Melampodium leucanthum)*
dwarf lousewort *(Pedicularis centranthera)*
Wrights buckwheat *(Eriogonum wrightii)*

BRIEF PLANT ID NOTES

The scientific name for Arizona pinyon has been variable. The most current accurate name is *Pinus californiarum* var. *fallax*. This name however is rarely used. More common names include *Pinus fallax* or *Pinus edulis* var. *fallax*.

The dark mahogany-colored bark of the manzanita is smooth. The manzanita shrub, which can root from drooping branches and form extensive thickets, has thick, leathery lime-green leaves.

SYNONYMY

mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical), +1 (cool, mesic)
Climate class: LSM (low sun mild)

PHASES

No phases are described here for this type, however, Moir & Carleton (1987) list: *Pinus monophylla/Arctostaphylos pungens/Quercus turbinella* and *Pinus monophylla/Arctostaphylos pungens/Quercus turbinella, Quercus emoryi* phase.

FIRE ECOLOGY

Although not documented, fires are probably a major disturbance factor considering the strong expression of manzanita.

REFORESTATION

Generally, abundant shrubs may inhibit natural and artificial tree seedlings. Seed tree and clear cut firewood harvesting will favor grasses, shrubs, and possibly encourage alligator juniper (if present) sprouting. A study in central Arizona (Soeth *et al*. 1995) showed firewood harvest increased forage and reduced soil loss. Selective and light shelterwood harvesting can maintain Arizona pinyon presence in stands. Shading is critical to pinyon seedling survival.

REVEGETATION CONSIDERATIONS

A rapid revegetation of shrubs can be expected following disturbances. Manzanita re-establishes from seed. Shrub live oak, mountain mahoghany, and many other shrubs often resprout following disturbance.

COMMENTS

This plant association has potential for browse production and for hiding cover.

REFERENCE(S)

Harris 1988
Moir & Carleton 1987
Soeth *et al*. 1995
TES - no. Tonto (1986)
TES - Globe RD (1984)
USFS 1987b

Arizona pinyon pine/blue grama
Pinus fallax/Bouteloua gracilis

PIFA/BOGR2

SYNONYMS

Expect this to change to *Pinus californiarum* var. *fallax/Bouteloua gracilis* (PICAF/BOGR2).

CODE(S)

alligator juniper (JUDE2) phase	2 33 02 0
Utah juniper (JUOS) phase	2 33 02 1
cliffrose (PUST) phase	2 33 02 2

KEY CRITERIA

A pinyon-juniper woodland with a rich understory of grasses, usually including blue grama *(Bouteloua gracilis)*. ***Arizona pinyon** is the dominant tree, along with either alligator juniper (JUDE2 phase) or Utah juniper (JUOS phase).

STRUCTURE

This type can produce considerable forage in terms of grass, particularly when tree densities are minor. Trees can also be productive on this site; one estimate of site index is 30 for Arizona pinyon pine. There is a relatively broad range of productivity potential for firewood. The forage value rating for cattle is high in early seral conditions and moderate in late seral conditions. A study in central Arizona (Soeth *et al*. 1995) showed firewood harvest increased forage and reduced soil loss.

LOCATION

Primarily known from central Arizona south of the Mogollon Rim (Prescott and Tonto National Forests and Ft. Apache Reservation). Occurs on elevated plains and alluvial valley plains. Elevations range from 4,900' - 5,600' (1,495 - 1,705 m). Mean annual precipitation (MAP) is around 22"/yr; mean annual air temperature (MAAT) = 52-56 degrees F.

ALSO SEE

PIED/BOGR2 is generally centered in HSC climates. See TES mapping unit 4170 on north portion of the Tonto NF (USFS 1986). PIFA/BOGR2 appears to be similar to JUDE2/BOGR2. PIFA/BOGR2 may historically have been an open woodland, while JUDE2/BOGR2 was a juniper savanna. With fire suppression and livestock grazing, these types are developing thick overstories of trees (Norm Ambos, pers. comm. 1996).

TREES

Abundant (>25%):
Arizona pinyon *(Pinus fallax)*
Utah juniper *(Juniperus osteosperma)*
alligator juniper *(Juniperus deppeana)*
Emory oak *(Quercus emoryi)*
[occasional, <5% cover when present]
Arizona white oak *(Quercus arizonica)*
[occasional, <5% cover when present]

SHRUBS

Scarce (<1%) to common (>1%):
shrub live oak *(Quercus turbinella)*
sacahuista *(Nolina microcarpa)*
red barberry *(Mahonia haematocarpa)*
Fremont mahonia *(Mahonia fremontii)*
Stansbury cliffrose*(Purshia stansburyiana)*
cholla & pricklypear *(Opuntia* spp.)
broom snakeweed *(Gutierrezia sarothae)*
Wrights buckwheat *(Eriogonum wrightii)*

HERBS

Abundant (>25%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
Fendler threeawn
(Aristida purpurea var. *longiseta)*
threeawn *(Aristida* spp.)

sand dropseed *(Sporobolus cryptandrus)*
common wolfstail *(Lycurus phleoides)*
Herter cane bluestem *(Bothriochloa barbinodis)*
little bluestem *(Schizachyrium scoparium)*
curlymesquite *(Hilaria belangeri)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
bottlebrush squirrel tail *(Elymus elymoides)*
needlegrass *(Stipa* spp.)
western wheatgrass *(Pascopyrum smithii)*

CRYPTOGAMS

Cryptogamic crusts may be important for erosion control and may be damaged by increased foot traffic, grazing, and tree canopy cover. See Ladyman, Muldavin, and Fletcher (1993) for a study of cryptogamic crusts in a similar PIED/BOGR2 plant association.

BRIEF PLANT ID NOTES

The inflorescence or "flag" can be used to distinguish blue grama from hairy grama *(Bouteloua hirsuta)*. On blue grama, the flag is curved and the terminal awn is shorter than the width of the flag. This awn is longer on hairy grama which also has straight flags.

SYNONYMY

red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, mesic) [JUDE2 phase]
0 (typical) [JUOS phase]
Climate class: LSM (low sun mild)

PHASES

PIFA/BOGR2 has three phases. The Utah juniper phase is more mesic than the Alligator juniper phase. The cliffrose phase has a strong expression of cliffrose.

FIRE ECOLOGY

Burning in this site usually encourages grasses. Check the "Fire Ecology" section for a review of research on fire in the similar PIED/BOGR2 plant association description. When blue grama is dormant (early spring, driest part of summer), it is less likely to be damaged by fires. Re-establishment of blue grama occurs through rhizomes (Tirmenstein 1987b). A 3 to 4 month rest from grazing is recommended for burned sites (Tirmenstein 1987b).

REFORESTATION

On some sites, junipers or tall shrubs serve as nurse plants for natural regeneration of Arizona pinyon. Shading is critical for the first 8 to 10 years for pinyon seedling survival. Mechanical site preparation may encourage juniper and oak regeneration. Burning encourages non-woody vegetation.

REVEGETATION CONSIDERATIONS

When oak is present, revegetation can be rapid. Without a prolific sprouter, revegetation is slow to moderate.

COMMENTS

This plant association can be important for livestock grazing. Yearlong or cool season grazing has often reduced or eliminated cool season grasses while favoring shrubs and short statured warm season grasses. There is fair potential for big game hiding cover in late seral stages.

REFERENCE(S)

Ladyman, Muldavin & Fletcher 1993
Soeth *et al*. 1995
TES- no portion of the Tonto NF
Tirmenstein 1987b
USFS 1987b

Arizona pinyon pine/ crucifixion thorn Pinus fallax/Canotia holacantha

PIFA/CAHO3

SYNONYMS

Expect this to change to *Pinus californiarum* var. *fallax/Canotia holacantha* (PICAF/CAHO3).

CODE(S)

typic phase 2 33 03 0

KEY CRITERIA

A pinyon-juniper woodland amid a shrubby and grassy matrix containing ***crucifixion thorn**.

STRUCTURE

This type is subject to soil erosion. A reported site index for pinyon is 25. The forage value rating for cattle is low to none.

LOCATION

Found in central Arizona south of the Mogollon Rim (including Prescott and Tonto National Forests, Fort Apache and San Carlos Apache Reservations), this association occurs on dissected, erosional escarpments and hills from 3,500' to 4,000' (1,075 - 1,225 m). Mean annual precipitation (MAP) = 20"/yr. Mean annual air temperature (MAAT) = 59-61 degrees F.

ADJACENT HABITAT TYPES

On elevated plains in the Prescott National Forest, PIFA/CAHO3 adjoins mesquite grasslands.

ALSO SEE

TES Mapping Unit 3770 in northern portion of the Tonto NF consists of a PIMO/JUOS/QUTU2/ARPU5/CAHO3 subseries on a loamy-skeletal, calcareous Typic Ustochrept.

TREES

Well represented (>5%):
Arizona pinyon *(Pinus fallax)*
Utah juniper *(Juniperus osteosperma)*
redberry juniper *(Juniperus erythrocarpa)*

SHRUBS

Well represented (>5%):
*crucifixion thorn *(Canotia holacantha)*
shrub live oak *(Quercus turbinella)*
banana yucca *(Yucca baccata)*
soaptree yucca *(Yucca elata)*
common sotol *(Dasylirion wheeleri)*
red barberry *(Mahonia haematocarpa)*
featherplume *(Dalea formosa)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
pointleaf manzanita *(Arctostaphylos pungens)*
redberry buckthorn *(Rhamnus crocaea)*
Stansbury cliffrose*(Purshia stansburyiana)*
broom snakeweed *(Gutierrezia sarothae)*

HERBS

Common (>1%) or well represented (>5%):
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
rough tridens *(Tridens muticus* var. *elongatus)*
threeawn *(Aristida* spp.)
New Mexico needlegrass *(Stipa neomexicana)*
muttongrass *(Poa fendleriana)*
bottlebrush squirreltail *(Elymus elymoides)*
plains blackfoot *(Melampodium leucanthum)*

BRIEF PLANT ID NOTES

• Arizona pinyon usually has one needle/fascicle, but occasionally has ones and twos on the same tree.

• Redberry juniper generally occurs below the Mogollon Rim, while oneseed juniper occurs above the Mogollon Rim. See JUER/CAHO3 for notes on sorting these out in the vicinity of the Mogollon Rim.

• Crucifixion thorn is a distinctive shrub or small tree. Often dominated by stems, as the leaves are drought deciduous. The woody, oval fruit stays on the stem through spring and splits into 5 parts.

SYNONOMY

redberry juniper *(Juniperus erythrocarpa = J. coahuilensis)*

red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*

Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*

bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

rough tridens *(Tridens muticus* var. *elongatus = Tridens elongatus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSM (low sun mild)

REFORESTATION

Shading is essential for pinyon seedling survival. Planting projects may have poor survival rates.

REVEGETATION CONSIDERATIONS

Natural revegetation is slow.

COMMENTS

High erosion potential must be considered in any activity.

REFERENCE(S)

Fletcher 1985
Stuever 1995
USFS 1987b

Arizona pinyon/shrub live oak
Pinus fallax/Quercus turbinella

PIFA/QUTU2

CODE(S)

vegetation	2 33 04 0
typic phase	2 33 04 1
cliffrose (PUST) phase	2 33 04 2

SYNONYMS

Expect this to change to *Pinus californiarum* var. *fallax*/*Quercus turbinella* (PICAF/QUTU2).

KEY CRITERIA

***Arizona pinyon,** Utah juniper, and oneseed juniper are found in the overstory of this shrubby woodland. ***Shrub live oak** is well represented and often abundant. Crucifixion thorn is absent, mountain mahogany is poorly represented, and manzanita is scarce or absent. The cliffrose phase is on calcareous soils.

LOCATION

Primarily found in central Arizona mostly south of the Mogollon Rim tapering to occasional stands near the NM border, this association occurs on a wide variety of soils and landforms. This association may represent the lowest elevational limits of Arizona pinyon.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:	4 (woodlands)
Elevational Subzone:	0 (typical)
Climate class:	LSM (high sun mild)

TREES

Abundant (>25%):
***Arizona pinyon** *(Pinus fallax)*
Utah juniper *(Juniperus osteosperma)*
oneseed juniper *(Juniperus monosperma)*
Emory oak *(Quercus emoryi)* [occasional]

SHRUBS

Well represented (>5%) or abundant (>25%):
***shrub live oak** *(Quercus turbinella)*
skunkbush sumac *(Rhus trilobata)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
true mountain mahogany *(Cercocarpus montanus)*
red barberry *(Mahonia haematocarpa)*
banana yucca *(Yucca baccata)*
sacahuista *(Nolina microcarpa)*
fourwing saltbush *(Atriplex canescens)*
tulip pricklypear *(Opuntia phaeacantha)*
walkingstick cactus *(Opuntia spinosior)*
on calcareous soils (PUST phase):
Stansbury cliffrose*(Purshia stansburyiana)*
desert ceanothus*(Ceanothus greggii)*
rough mendora *(Mendora scabra)*
bastardsage *(Eriogonum wrightii)*
broom snakeweed *(Gutierrezia sarothae)*

HERBS

Well represented (>5%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
threeawn *(Aristida* spp.)
sand dropseed *(Sporobolus cryptandrus)*
common wolfstail *(Lycurus pheloides)*
Herter cane bluestem *(Bothriochloa barbinodis)*
little bluestem *(Schizachyrium scoparium)*
curlymesquite *(Hilaria belangeri)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
bottlebrush squirreltail *(Elymus elymoides)*
needlegrass *(Stipa* spp.)
numerous forbs

BRIEF PLANT ID NOTES

• Arizona pinyon *(Pinus fallax)* usually has one needle/fascicle, but occasionally has two, with ones and twos on the same tree.

• Shrub live oak has thick, stiff, evergreen leaves with spine-tipped teeth. The upper leaf surface is blue-green, and yellow-green beneath. Leaves are small for oaks, approx. 1/2" to 1-1/4" long.

SYNONOMY

red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

ALSO SEE

Common occurrence of Arizona pine separate PIFA/QUTU2 from JUER/QUTU2. Manzanita may be accidental in PIFA/QUTU2, but becomes common or well-represented in PIFA/ARPU5.

STRUCTURE

The understory can appear as a patchy mosaic of shrubs amid corridors of grasses and half shrubs. This relationship between shrub live oak, grasses and conifer densities can be dynamic. This type generally has a low forage value rating for cattle in early succession, and no forage value for cattle at late succession. A recorded site index for pinyon = 20.

FIRE ECOLOGY

Frequent fire can favor oak dominance and slow succession to a conifer woodland, producing chaparral vegetation. (Johnson *et al*. 1962)

REFORESTATION

Firewood harvest by clearcut or seedtree methods will favor oak and shrub species rather than pinyon and juniper. Conifer regeneration can be encouraged through selection and shelterwood harvesting. Plant pinyon seedlings among woody debris to provide shading for 8 to 10 years. Planting is not a common practice.

REVEGETATION CONSIDERATIONS

Can be rapid due to oak resprouting.

COMMENTS

This plant association may provide browse cover for deer.

REFERENCE(S)

Johnson *et al*. 1962
Moir & Carleton 1987
USFS 1987b

Arizona pinyon pine/banana yucca PIFA/YUBA
Pinus fallax/Yucca baccata

SYNONYMS
Expect this to change to *Pinus californiarum* var. *fallax/Yucca baccata* (PICAF/YUBA).

CODE(S)
typic phase 2 33 05 0

KEY CRITERIA
Tree cover is luxuriant with an overstory of Arizona pinyon, Utah juniper and possibly oneseed juniper. Herbs are scarce, primarily annuals, and shrubs are common.

STRUCTURE
This association has a moderate potential for fuelwood production. One measured site index for pinyon for this association is 25. There is little to no potential for livestock grazing. Where this association occurs on steep, rocky sites, expect slow growth which is unable to sustain grazing, and prone to erosion upon disturbance. There is potential for wildlife hiding cover.

LOCATION
Presently known from Ft. Apache Reservation where it occurs on steep south or west slopes around 6,200' (1,890 m).

ALSO SEE
PIFA/sparse community type is perhaps indistinguishable.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typical)
Climate class: LSM (low sun mild)

TREES
Luxuriant (>50%):
Arizona pinyon *(Pinus fallax)* C
Utah juniper *(Juniperus osteosperma)* S
oneseed juniper
(Juniperus cf monosperma) c
gray oak *(Quercus* X *grisea)* [occasional]

SHRUBS
Common (>1%):
shrubby forms of gray oak *(Quercus* x *grisea)*
hybrids of shrub live oak
(Quercus x *turbinella)*
banana yucca *(Yucca baccata)*
skunkbush sumac *(Rhus trilobata)*
true mountain mahogany
(Cercocarpus montanus)
broom snakeweed *(Gutierrezia sarothae)*

HERBS
Scarce (<1%):
buckwheat *(Eriogonom* spp.)
annuals

BRIEF PLANT ID NOTES
At Fort Apache Reservation, Arizona pinyon and twoneedle pinyon *(Pinus edulis)* may hybridize at sites within this association.

FIRE ECOLOGY
No fire ecology information specifically for this plant assocation is available. Banana yucca generally survives fires by sprouting from underground rhizomes (Tirmenstein 1989b).

REFORESTATION

Firewood harvest using a selection method or shelterwood method may be sustainable, but opening the stand through clearcuts or seed tree cuts would favor shrubs and junipers. No information on planting success is available; however, shading is probably essential to pinyon seedling survival.

REVEGETATION CONSIDERATIONS

Natural revegetation is slow.

COMMENTS

Steep slopes are prone to erosion, particularly when disturbed.

REFERENCE(S)

Tirmenstein 1989b
USFS 1987b

border pinyon/Mexican orange PIDI3/CHDUA

(Formerly: border pinyon/star-leaf)

Pinus discolor/Choisya dumosa var. arizonica

(Formerly: Pinus discolor/Choisya arizonica)

SYNONYMS

Pinus discolor/Choisya arizonica
USFS 1987b
Pinus discolor-Quercus arizonica/Nolina microcarpa (Moir & Carleton 1987 [ed. 1])

CODE(S)

typic phase 2 32 02 0

KEY CRITERIA

This woodland is usually well stocked with ***border pinyon**, alligator juniper and occasional Arizona white oak in the canopy. The shrub dominated understory includes ***Mexican orange**, but oaks or mountain mahogany are poorly represented (<5%).

LOCATION

Known from the Dragoon Mountains in southeastern Arizona, this type has been found on steep, north-facing slopes around 6,500' (1,980 M). Parent materials are limestone and altered limestone. Mean annual precipitation (MAP) = 20 in/yr.

TREES

Luxuriant (>50%):
border pinyon *(Pinus discolor)* C
alligator juniper *(Juniperus deppeana)* c
Arizona white oak *(Quercus arizonica)* s

SHRUBS

Common (>1%) to well represented (>5%):
*Mexican orange *(Choisya dumosa* var. *arizonica)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
cliff fendlerbush *(Fendlera rupicola)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus)*
sacahuista *(Nolina microcarpa)*
common hoptree *(Ptelea trifoliata)*
walkingstick cactus *(Opuntia spinosior)*

HERBS

Scarce to common (< or > 1%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
prairie junegrass *(Koeleria macrantha)*
Fendler lipfern *(Cheilanthes fendleri)*
alpine pennycress*(Thlaspi montanum)*

BRIEF PLANT ID NOTES

Border pinyon has two to three needles/fascicle. Needles have a distinct white or silver line.

Mexican orange, also known as star-leaf, has whorls of 8, narrow, wavy margin leaflets. Flowers are five-petaled.

SYNONYMY

Mexican orange *(Choisya dumosa* var. *arizonica = C. arizonica)*
alpine pennycress*(Thlaspi montanum* var. *montanum = T. alpestre)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, wet)
Climate class: HSM (high sun mild)

REFERENCE(S)

Moir & Carleton 1987
USFS 1987b

border pinyon/bullgrass Pinus discolor/ Muhlenbergia emersleyi

PIDI3/MUEM

CODE(S)

typic phase 2 32 03 0

KEY CRITERIA

A grassy woodland on moderate to steep slopes occurring in southeastern Arizona and southwestern New Mexico. Bullgrass is usually present, although it may be lacking in some locations. ***Border pinyon** and Alligator juniper dominate the overstory, and oaks are present but scarce in the overstory.

STRUCTURE

There is very little documented information about this type.

LOCATION

Presently known from southeastern Arizona, and southwestern New Mexico, but probably occurs in northern Mexico also. Usually on moderate to steep, north-facing colluvial slopes from 5,800' - 6,600' (1,770 -2,010 m). Soils are erosional and may be very shallow (<5") and interrupted by exposed bedrock. Mean annual precipitation (MAP)=18-19 "/yr.

ADJACENT HABITAT TYPES

On shallow rocky soils of the southern Peloncillos, NM, PIDI3/MUEM and QUEM/ARPU form complicated mosaics and gradational associations.

ALSO SEE

Moir (1979); *Pinus discolor-Nolina microcarpa-Muhlenbergia emersleyi* h.t. of Willging (1987).

TREES

Well represented (>5%), total oak tree cover is <1%:
*border pinyon *(Pinus discolor)*
alligator juniper *(Juniperus deppeana)*
Arizona white oak *(Quercus arizonica)*
Arizona white oak-gray oak hybrids *(Quercus arizonica X grisea)*
Emory oak *(Quercus emoryi)*

SHRUBS

Common (>1%):
Toumey oak *(Quercus toumeyi)*
Toumey oak hybrids with gray oak *(Quercus toumeyi X grisea)*
gray oak *(Quercus grisea)* [shrubby]
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
cliff fendlerbush *(Fendlera rupicola)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus)*
sacahuista *(Nolina microcarpa)*
common sotol *(Dasylirion wheeleri)*
gumhead *(Gymnosperma glutinosum)*
Schott yucca *(Yucca schottii)*
banana yucca *(Yucca baccata)*
broom snakeweed *(Gutierrezia sarothae)*
pointleaf manzanita *(Arctostaphylos pungens)*

HERBS

Well represented (>5%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
slender grama *(Bouteloua repens)*
plains lovegrass *(Eragrostis intermedia)*
bullgrass *(Muhlenbergia emersleyi)*
slimflower muhly *(Muhlenbergia tenuifolia)*
prairie junegrass *(Koeleria macrantha)*

nodding brome *(Bromus anomalus)*
bottlebrush squirreltail *(Elymus elymoides)*
Texas bluestem *(Schizachyrium cirratum)*
ferns *(Cheilanthes, Bommeria, Pellaea)*

BRIEF PLANT ID NOTES

Bullgrass is similar to some other large bunchgrasses in the *Muhlenbergia* genus. Longtongue muhly *(M. longiligula)* has more rounded sheaths at the base, where bullgrass is flattened. There are deciduous awns on the lemmas of bullgrass, but no awns on longtongue muhly (i.e. if you see awns, it could be bullgrass; if you don't see awns, it could be either). Deergrass *(M. rigens)* looks similar but is found in draws and drainages. (Stuever 1995).

SYNONYMY

slimflower muhly *(Muhlenbergia tenuifolia = M. monticola)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic), +1 (cool, mesic)
Climate class: HSM (high sun mild)

COMMENTS

Important habitat for Gould's turkey (Willging 1987).

REFERENCE(S)

Moir 1979
Moir 1982
Moir & Carleton 1987
Stuever 1995
USFS 1986
Willging 1987

border pinyon/pinyon ricegrass PIDI3/PIFI
Pinus discolor/Piptochaetium fimbriatum

CODE(S)
typic phase 2 32 04

KEY CRITERIA
This woodland is found in washes, drainages, and other alluvial settings. ***Border pinyon** is the dominant tree species. The understory is dominated by grasses and may include pinyon ricegrass, although it is not always present. The shrub layer may be minor or significant, and includes oaks and yuccas.

LOCATION
Occurs in southeastern Arizona and central and southwestern New Mexico. Elevations range from 5,500' - 6,000' (1,680-1,830 M) often on north slopes. Soils may be Typic Ustifluvents and Cumulic and Typic Ustochrepts. Mean annual precipitation (MAP) = 18-19"/yr.

ALSO SEE
PIDI3/MUEM is mostly on colluvial slopes and pinyon ricegrass is poorly represented in the grass assemblage. There is very little description of PIDI3/PIFI at present. The importance of PIDI3/PIFI to Gould's turkey habitat is discussed by Willging (1987).

TREES
Abundant (>25%):
border pinyon *(Pinus discolor)*
alligator juniper *(Juniperus deppeana)*
gray oak *(Quercus grisea)*
gray oak hybrids to Arizona white oak *(Quercus grisea X arizonica)*

SHRUBS
Common (>1%):
Toumey oak *(Quercus toumeyi)*
Toumey oak hybrids with gray oak *(Quercus toumeyi X grisea)*
gray oak *(Quercus grisea)* [shrubby]
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
cliff fendlerbush *(Fendlera rupicola)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus)*
sacahuista *(Nolina microcarpa)*
Schott yucca *(Yucca schottii)*
banana yucca *(Yucca baccata)*
broom snakeweed *(Gutierrezia sarothae)*
tulip pricklypear *(Opuntia phaeacantha)*
pointleaf manzanita *(Arctostaphylos pungens)*

HERBS
Well represented (>5%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
plains lovegrass *(Eragrostis intermedia)*
bullgrass *(Muhlenbergia emersleyi)*
prairie junegrass *(Koeleria macrantha)*
nodding brome *(Bromus anomalus)*
bottlebrush squirreltail *(Elymus elymoides)*
Texas bluestem *(Schizachyrium cirratum)*
Kunth onion *(Allium kunthii)*
New Mexico groundsel *(Senecio neomexicanus)*
wild beans *(Phaseolus* spp.)

BRIEF PLANT ID NOTES
When the seedheads are on the plant, pinyon ricegrass is hard to miss as the seeds are large for grasses and the open panicle and long awns give the plant a distinctive appearance. Most of the narrow leaves originate at the base, and there are woolly hairs just below the nodes of the culm. (Stuever 1995.)

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus = C. breviflorus)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, wet)
0 (typic)
Climate class: HSM (high sun mild)

REFORESTATION

Like other pinyons, border pinyon seedlings do best with shade.

REFERENCE(S)

Stuever 1995
USFS 1987b
Willging 1987

border pinyon/silverleaf oak PIDI3/QUHY
Pinus discolor/Quercus hypoleucoides

CODE(S)
typic phase 2 32 06 0

KEY CRITERIA
A shrub-dominated woodland on moderate to steep slopes occurring in southeastern Arizona and southwestern New Mexico. Shrubs include a mix of oaks, manzanita, and others, but ***silverleaf oak** is at least common. ***Border pinyon** and Alligator juniper dominate the overstory, and ponderosa pine *(Pinus ponderosa)* and Chihuahua pine *(Pinus leiophylla)* may be occasional on microsites.

STRUCTURE
There is very little documented information about this type.

LOCATION
Presently known from southeastern Arizona in the Chiricahua and Santa Catalina Mountains and on the Clifton Ranger District near the New Mexico border, and in extreme southwestern New Mexico in the Animas Mountains. Often on steep, upper slopes and ridgetops, and elevated plains from 6,200' - 7,000' (1,890 -2,130 M). Soils are extremely rocky, or shallow and rocky, often broken by rock outcrops. Mean annual precipitation (MAP) = 20-21"/yr; mean annual air temperature (MAAT) = 53 degrees F with relatively mild winters.

ALSO SEE
Pygmy conifer, oak scrub described by Niering & Lowe (1984); Wagner (1977). TES mapping unit 691 on the Clifton Ranger District. Otherwise a poorly described association.

TREES
Well represented (>5%):
***border pinyon** *(Pinus discolor)*
alligator juniper *(Juniperus deppeana)*

SHRUBS
Abundant (>25%):
***silverleaf oak** *(Quercus hypoleucoides)*
netleaf oak *(Quercus rugosa)*
sacahuista *(Nolina microcarpa)*
Pringle manzanita *(Arctostaphylos pringlei)*
pointleaf manzanita
(Arctostaphylos pungens)
Wright silktassel *(Garrya wrightii)*
Parry agave *(Agave parryi)*
skunkbush sumac *(Rhus trilobata)*
Gambel oak *(Quercus gambelii)*

HERBS
Scarce (<1%), might include:
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
prairie junegrass *(Koeleria macrantha)*
Arizona wheatgrass *(Elymus arizonicus)*
woolly brome *(Bromus lanatipes)*
fringed brome *(Bromus ciliatus)*
muttongrass *(Poa fendleriana)*
bullgrass *(Muhlenbergia emersleyi)*
[lower elevations]
falsepennyroyal *(Hedeoma hyssopifolia)*
pineywoods geranium
(Geranium caespitosum)
Fendler meadowrue *(Thalictrum fendleri)*

BRIEF PLANT ID NOTES
The distinctive lance-shaped bicolor leaf of silverleaf oak is hard to mistake. The undersides have a woolly white pubescence that contrasts sharply with dark green, smooth upper leaf surface. Leaf margins are entire and rolled in.

SYNONYMY
Arizona wheatgrass *(Elymus arizonicus = Andropogon arizonicum)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: +1 (cool, mesic)
Climate class: HSM (high sun mild)

REFORESTATION

Shading may be important to pinyon seedling survival.

REFERENCE(S)

Niering and Lowe 1984
USFS 1987b
Wagner 1977

border pinyon/Toumey oak
Pinus discolor/Quercus toumeyi

PIDI3/QUTO2

CODE(S)

typic phase 2 32 05 0

KEY CRITERIA

A shrubby woodland on rhyolite parent materials occurring in southeastern Arizona and southwestern New Mexico. ***Toumey oak** or its hybrids are present. ***Border pinyon**, Alligator juniper, and redberry juniper dominate the overstory.

STRUCTURE

There is very little documented information about this type.

LOCATION

Presently known from southeastern Arizona and extreme southwestern New Mexico (Animas Mountains), but probably occurs in northern Mexico also. On rhyolite parent materials, usually from 5,900' - 6,100' (1,800 -1,860 M). Mean annual precipitation (MAP) = 19"/yr; mean annual air temperature (MAAT) = 58 degrees F.

ALSO SEE

Smith (1974); chaparral woodland in Moir (1979); the shrubby element of *Pinus discolor-Quercus toumeyi-Muhlenbergia emersleyi* h.t. of Willging (1987). PIFA/ARPU5 occurs in LSM climates elsewhere south of the Mogollon Rim.

TREES

Well represented (>5%):
border pinyon *(Pinus discolor)
alligator juniper *(Juniperus deppeana)*
redberry juniper *(Juniperus erythrocarpa)*
Emory oak *(Quercus emoryi)* [occasional]

SHRUBS

Abundant (>25%):
*Toumey oak *(Quercus toumeyi)*
Toumey oak hybrids with gray oak *(Quercus toumeyi X grisea)*
pointleaf manzanita *(Arctostaphylos pungens)*
Wright silktassel *(Garrya wrightii)*
skunkbush sumac *(Rhus trilobata)*
leatherleaf sumac *(Rhus coriophylla)*
sacahuista *(Nolina microcarpa)*
Schott yucca *(Yucca schottii)*
Palmer century plant *(Agave palmeri)*
common sotol *(Dasylirion wheeleri)*

HERBS

Scarce to common (< or > 1%), might include:
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
sideoats grama *(Bouteloua curtipendula)*
bullgrass *(Muhlenbergia emersleyi)*
plains lovegrass *(Eragrostis intermedia)*
blue grama *(Bouteloua gracilis)*
common wolftail *(Lycurus phleoides)*
pinyon ricegrass *(Piptochaetium fimbriatum)*
bulb panicgrass *(Panicum bulbosum)*
bean (*Phaseolus* spp.)
ticktrefoil (*Desmodium* spp.)

BRIEF PLANT ID NOTES

The oval to elliptic, small (1/2" to 3/4" long) leaves of the Toumey oak are numerous and crowded on this shrubby oak. The yellow-green leaves are shiny on the upper surfaces, and slightly hairy beneath. (Stuever 1995).

SYNONYMY

Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: HSM (high sun mild)

REFORESTATION

Shading may be important to pinyon seedling survival.

REFERENCE(S)

Moir 1979
Moir & Carleton 1987
Smith 1974
Stuever 1995
USFS 1987b
Willging 1987

border pinyon/evergreen sumac PIDI3/RHVIC

(Formerly: border pinyon/leatherleaf sumac)

Pinus discolor/Rhus virens var. choriophylla

(Formerly: Pinus discolor/Rhus coriophylla)

SYNONYMS

Pinus discolor/Cercocarpus breviflorus-Rhus coriophylla (Moir & Carleton 1987)
Pinus discolor/Rhus coriophylla (USFS 1987b)

CODE(S)

typic phase 2 32 07 0

KEY CRITERIA

A shrubby pinyon-juniper woodland occurring in southeastern Arizona. ***Mountain mahogany** is well-represented and leatherleaf sumac is usually present to well-represented; oaks are not a significant part of the shrub mix. ***Border pinyon** and redberry juniper dominate the overstory.

STRUCTURE

There is very little documented information about this type.

LOCATION

Presently known from southeastern Arizona (Mule and Huachuca Mountains). Found on limestone parent materials from around 5,500' (1675 m) on north slopes to 6,500' (1980 m) on south slopes. Mean annual precipitation (MAP) = 19"/yr; mean annual air temperature (MAAT) = 55 degrees F; mean January air temperature = 46 degrees F (Fort Huachuca).

ALSO SEE

Wentworth (1981, 1985).

TREES

Well represented (>5%):
border pinyon *(Pinus discolor)*
redberry juniper *(Juniperus erythrocarpa)*

SHRUBS

Well represented (>5%) to abundant (>25%):
***hairy mountain mahogany** *(Cercocarpus montanus* var. *paucidentatus)*
evergreen sumac *(Rhus virens* var. *choriophylla)*
common sotol *(Dasylirion wheeleri)*
Utah fendlerbush *(Fendlera utahensis)*
Wright silktassel *(Garrya wrightii)*

HERBS

Well represented (>5%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
slender grama *(Bouteloua repens)*
plains lovegrass *(Eragrostis intermedia)*
bullgrass *(Muhlenbergia emersleyi)*
needlegrass *(Stipa* spp.)
ferns *(Cheilanthes, Bommeria, Pellaea, Notholaena)*

BRIEF PLANT ID NOTES

Evergreen sumac, also known as leatherleaf sumac, has shiny green upper leaf surfaces with a yellowish green lower leaf surface. Leaflets usually occur in groups of three, or may be single. The gray-red bark has reddish bumps.

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus = C. breviflorus)*
evergreen sumac = leatherleaf sumac *(Rhus virens* var. *choriophylla = R. coriophylla)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: 0 (typic)
Climate class: HSM (high sun mild)

REFORESTATION

Select microsites for planting pinyon seedlings which provide shade and needle litter for mulch.

COMMENTS

Wentworth (1981) felt this association had more affinity with the Chihuahua desert rather than the Sonoran desert than nearby plant associations on granite-derived soils. He credits a drier environment, cooler winter temperatures, and tolerance for calcareous soils as reasons the Chihuahuan flora prevails.

REFERENCE(S)

Moir & Carleton 1987
USFS 1987b
Wentworth 1985
Wentworth 1981

alligator juniper/ pointleaf manzanita
Juniperus deppeana/Arctostaphylos pungens

JUDE2/ARPU5

CODE(S)
typic phase 2 31 01 0

KEY CRITERIA
A juniper woodland wherein ***alligator juniper** is dominant with an abundant (>25% cover) shrubby understory .

STRUCTURE
Alligator juniper is the overstory dominant.

LOCATION
Known from a single location at the foot of the Bradshaw Mountains, Arizona (T11-1/2 N, R1W, Sec. 24; G&SRB&M); at approximately 5,300 feet (1,610 m) on Typic Haplustalfs on a variety of slopes.

ALSO SEE
PIFA/ARPU. The absence of *Pinus fallax* distinguishes JUDE/ ARPU.

TREES
Well represented (>5% cover)**:**
***alligator juniper** *(Juniperus deppeana)*
Emory oak *(Quercus emoryi)*
redberry juniper *(Juniperus erythrocarpa)*

SHRUBS
Abundant (>25% cover)**:**
***pointleaf manzanita** *(Arctostaphylos pungens)*
Pringle manzanita *(Arctostaphylos pringlei)*
shrub live oak *(Quercus turbinella)*
true mountain mahogany *(Cercocarpus montanus)*
skunkbush sumac *(Rhus trilobata)*
mimosa *(Mimosa aculealicarpa* var. *biuncifera)*
desert ceanothus *(Ceanothus greggii)*
sugar sumac *(Rhus ovata)*
Wright silktassel *(Garrya wrightii)*
broom snakeweed *(Gutierrezia sarothrae)*

HERBS
Scarce (<1% cover)**:**
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
three awns (*Aristida* spp.)

BRIEF PLANT ID NOTES
Alligator juniper is a native evergreen, scale-leaved tree with heavy primary branches, distinctive checkered or fissured bark, and a massive trunk capable of growing to diameters approaching 5 feet.

Pointleaf manzanita is a bushy, native, short-lived, evergreen, broadleaf shrub, approximately 5 to 7 feet (1.5 to 2 m) tall. Its leaves are oval-shaped with sharp pointed tips, bright green, leathery, and covered with soft, fine hairs. The stems are shiny red.

SYNONYMY
Mimosa *(Mimosa aculealicarpa* var. *biuncifera = M. biuncifera)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodland)
Elevational Subzone: 0 (typical)
Climate Class: LSM (low sun mild)

FIRE ECOLOGY
This may be a fire-edaphic climax plant community. Pointleaf manzanita does not sprout from the roots or crown following fire (Harris 1988a). It is a prolific seeder in response to fire. Such seed crops can be stored in the soil for decades. Pointleaf communities are characteristic of frequently burned areas with dry, coarse soils and are typically found in the

transition zone between chaparral and pine or oak woodlands

Alligator juniper is well adapted to survive most fires. It is capable of producing prolific sprouts/suckers even after significant consumption of the above ground portions of the plants. This allows alligator juniper to quickly regain dominance on most sites. Mortality of this juniper is quite low following many severe fires.

REFORESTATION

Wood harvesting methods: partial retention of the overstory, as usually produced by selection and shelterwood harvesting methods, provides microclimates favorable for regeneration of alligator juniper. Heavier removal of the overstory as seen in seedtree and clear cutting favors alligator juniper, manzanita and oak.

Site preparation techniques: alligator juniper and manzanita respond to a variety of techniques including mechanical and burning. Review TES reports for limitations due to shallow or rocky soils or high erosion potentials.

REVEGETATION CONSIDERATIONS

Revegetation is expected to be rapid due to the sprouting characteristics of alligator juniper and oak (Gottfried and Ffolliott. 1994).

COMMENTS

Forage value rating for cattle in early seral stage is low and none in the late seral.

REFERENCE(S)

Harris 1988a
Little 1950
Moir and Carleton 1987
Tirmenstein 1988
USFS 1986
USFS 1987b

alligator juniper/blue grama JUDE2/BOGR2
Juniperus deppeana/Boutelous gracilis

CODES

Typic phase	2 31 02 0
Mesquite (PRGL) phase	2 31 02 1

KEY CRITERIA

A juniper woodland wherein alligator juniper is dominant with a scarce (<1% cover) or common (>1% cover) shrubby understory. Gray oak is scarce (< 1% cover).

STRUCTURE

Alligator juniper is the overstory dominant. One average site index for pinyon is 25, indicating a low productivity for timber species.

LOCATION

Known from southern New Mexico and Arizona south of the Mogollon Rim; at approximately 5,200' (1,600 m) on north aspects and to 6,600' (2,610 m) on south aspects. JUDE2/BOGR2, PRGL Phase is presently known only from the New Mexico-Arizona border between Glenwood, NM and Clifton, AZ.

ALSO SEE

Souders (1985) mapping unit 3914. TES report for Apache-Sitgreaves NFs (USFS 1987b) has mapping units 587 and 589 within a JUDE2-NOMI subseries (mostly on the Clifton RD); MUs 512 and 582 within this subseries have very steep slopes and appear to intergrade to scarp woodland. For Globe RD, see MU 3914 and local sites of JUDE2/BOGR2 in MU 3828.

TREES

Well represented (>5% cover)**:**
alligator juniper *(Juniperus deppeana)*
[often 5-10% cover]
twoneedle pinyon *(Pinus edulis)*
[usually scarce (<1% cover) but sometimes common (>1% cover)].
oneseed juniper *(Juniperus monosperma)*
[scarce]
gray oak *(Quercus grisea)*
[scarce; a low tree or shrub]
Emory oak *(Quercus emoryi)*
[scarce; a low tree or shrub]
Utah juniper *(Juniperus osteosperma)*
[sometimes common]

SHRUBS

Scarce (<1% cover) or common (>1% cover)**:**
bastardsage *(Eriogonum wrightii)*
broom snakeweed *(Gutierrezia sarothrae)*
sacahuista *(Nolina microcarpa)*
common sotol *(Dasylirion wheeleri)*
banana yucca *(Yucca baccata)*
desert ceanothus *(Ceanothus greggii)*
tulip pricklypear *(Opuntia phaeacantha)*
dollarjoint pricklypear *(Opuntia chlorotica)*
walkingstick cactus *(Opuntia spinosior)*
fairyduster *(Calliandra eriophylla)*
honey mesquite *(Prosopis glandulosa)*
[common in mesquite phase]
yerba de pasmo *(Baccharis pterioinoides)*
Wrights buckwheat *(Eriogonum wrightii)*

HERBS

Abundant (>25% cover)**:**
Typic Phase and Mesquite Phase:
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
Carruth sagewort *(Artemisia carruthii)*
obtuse panicgrass *(Panicum obtusum)*
Typic Phase also includes:
bullgrass *(Muhlenbergia emersleyi)*
curlymesquite *(Bouteloua belangeri)*
plains lovegrass *(Eragrostis intermedia)*
poverty threeawn *(Aristida divaricata)*
needleandthread *(Stipa comata)*
dwarf stickpea *(Calliandra humilis)*
Mesquite Phase also includes:
yellow bristlegrass *(Setaria macrostachya)*
black grama *(Bouteloua eriopoda)*

BRIEF PLANT ID NOTES

Alligator juniper is a native evergreen, scale-leaved tree with heavy primary branches, distinctive checkered or fissured bark, and a massive trunk capable of growing to diameters approaching 5 feet.

Blue grama is a warm season, tufted perennial grass often with short, stout rhizomes. Its leaves have rounded sheaths with occasional to sparse long hairs. The most recognizable character is the softly to strongly curved terminal flowerhead, called a spike or a flag.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

	Typic Phase
Life Zone Class:	4 (Woodland)
Elevational Subzone:	0 (typical)
Climate Class:	HSM (High Sun Mild)
	Mesquite Phase
Life Zone Class:	4
Elevational Subzone:	-1
Climate Class:	HSM (High Sun Mild)

PHASES

Two phases are recognized. The typic phase is slightly moister and cooler and tends to support more pinyon and Utah juniper than the mesquite phase. The mesquite phase is warmer and drier and supports a higher percent cover of mesquite.

FIRE ECOLOGY

Alligator juniper is well adapted to survive most fires. It is capable of producing prolific sprouts/suckers even after significant consumption of the above ground portions of the plants. This allows alligator juniper to quickly regain dominance on most sites. Mortality of this juniper is quite low following many severe fires.

Blue grama is generally top-killed by fires. The rhizomes are usually unharmed. Blue grama is usually unharmed by fire during years with above normal winter and spring precipitation. Its response to fire varies from being harmed to almost unaffected to actually being increased by fire. Season of burning, soil moisture, temperature, plant community composition and fire severity are some of the factors affecting blue grama responses. Recovery time ranges from 1 to 4 years or more depending on conditions. White &Currie, 1981.

REFORESTATION

Wood harvesting methods: Partial retention of the overstory, as usually produced by selection and shelterwood harvesting methods, provides microclimates favorable for regeneration of alligator juniper. Heavier removal of the overstory as seen in seedtree and clear cutting favors alligator juniper, oak, and grass.

Site preparation techniques: Alligator juniper and manzanita respond to a variety of techniques including mechanical and burning. Review TES reports for limitations due to shallow or rocky soils, or high erosion potentials.

REVEGETATION CONSIDERATIONS

Revegetation is expected to be rapid due to the sprouting characteristics of alligator juniper and oak (Gottfried and Ffolliott, 1995).

COMMENTS

Typic phase: MAP = 19'/yr; MAAT = 55 deg. F; often heavy clay soils (see TES reports); mesquite phase: MAP = 16-18"/yr; MAAT = 54-56 deg. F; on elevated plains and gently sloping upper slopes and ridges, often of basaltic rock; Vertic or Typic Argiustolls with heavy clay horizion.

See TES reports for limitations on heavy clay soils and for other textural limitations.

REFERENCE(S)

Gottfried and Ffolliott 1995
Moir and Carleton 1987
Tirmenstein 1987b
Tirmenstein 1988a
USFS 1986
USFS 1987b

alligator juniper/desert ceanothus
Juniperus deppeana/ Ceanothus greggii

JUDE2/CEGR

SYNONYMS

mixed juniper/mountain mahogany-desert ceanothus; *Juniperus deppeana-Juniperus monosperma/Cercocarpus montanus-Ceanothus greggii;* JUDE2-JUMO/CEMO2-CEGR; also known as mixed juniper/mountain mahogany-deerbrush (USFS 1987b).

CODE(S)

typic phase 2 31 03 0

KEY CRITERIA

A juniper woodland wherein alligator juniper and oneseed juniper are codominant with a well represented (>5% cover) shrubby understory and ***true mountain mahogany** or ***desert ceanothus** is common (>1% cover). Twoneedle pinyon *(Pinus edulis)* may occur as an accidental tree.

STRUCTURE

Oneseed juniper is the overstory dominant and major climax species. Alligator juniper is a minor climax species. Twoneedle pinyon may exist as an accidental.

LOCATION

Sacramento and Guadalupe Mountains, NM; at elevations of 6,000' to 6,500' (1,824 to 1,975 m) on south slopes with limestone parent materials.

ALSO SEE

Woodin and Lindsey (1954) stations 19 and 20. Otherwise a poorly known plant association.

TREES

Well represented (>5% cover) often of low stature (<16 feet [4.9 m] tall)**:**
oneseed juniper *(Juniperus monosperma)*
alligator juniper *(Juniperus deppeana)*

SHRUBS

Well represented (>5% cover)**:**
***hairy mountain mahogany** *(Cercocarpus montanus* var. *paucidentata)*
***desert ceanothus** *(Ceanothus greggii)*
skunkbush sumac *(Rhus trilobata)*
wavyleaf oak *(Quercus* X *pauciloba)*
pricklyleaf dogweed *(Thymophylla acerosa)*
broom snakeweed *(Gutierrezia sarothrae)*
crown of thorns *(Koeberlinia spinosa)*
ocotillo *(Fouquieria splendens)*
tulip pricklypear *(Opuntia phaeacantha)*
soaptree yucca *(Yucca elata)*

HERBS

Well represented (>5% cover)**:**
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
sideoats grama *(Bouteloua curtipendula)*
Peruvian muhly *(Muhlenbergia pauciflora)*
curlyleaf muhly *(Muhlenbergia setifolia)*
plains lovegrass *(Eragrostis intermedia)*
slim tridens *(Tridens muticus)*
common wolftail *(Lycurus phleoides)*

BRIEF PLANT ID NOTES

Alligator juniper is a native evergreen, scale-leaved tree with heavy primary branches, distinctive checkered or fissured bark, and a massive trunk capable of growing to diameters approaching 5 feet.

Desert ceanothus is multi-branched, evergreen, native shrub growing to about 5 feet (1.5 m) in height. The leaves are small (1 inch [>2.5 cm] long), opposite, pinnately veined, elliptic to oblanceolate, thick with a smooth (entire) margin, grayish-green on the upper surface and paler on the lower surface. While there are no spines, the rigid branchlets end in a sharp point.

SYNONYMY

hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentata = C. breviflorus)*
pricklyleaf dogweed *(Thymophylla acerosa = Dyssodia acerosa)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSC (high sun cold)

REFERENCE(S)

Moir and Carleton 1987
Stuever 1995
Tirmenstein 1988a
USFS 1986
Woodin and Lindsey 1954

Alligator juniper/Bullgrass JUDE2/MUEM
Juniperus deppeana/Muhlenbergia emersleyi

CODES
typic phase 2 31 05 0

KEY CRITERIA
A juniper woodland wherein alligator juniper is dominant with a well represented (>5% cover) shrubby understory; gray oak is common (> 1% cover) and bull grass with its associates produce abundant (>25%) cover.

STRUCTURE
Alligator juniper is the overstory dominant.

LOCATION
Known only from Guadalupe Mountains, NM.

TREES
Well represented (>5% cover)**:**
alligator juniper *(Juniperus deppeana)*

SHRUBS
Well represented (>5% cover)**:**
oaks (*Quercus* spp.)
sacahuista *(Nolina microcarpa)*
green sotol *(Dasylirion leiophyllum)*
century plant (*Agave* spp.)

HERBS
Abundant (>25% cover)**:**
bullgrass (*Muhlenbergia emersleyi*)
and associated grasses

BRIEF PLANT ID NOTES
Alligator juniper is a native evergreen, scale-leaved tree with heavy primary branches, distinctive checkered or fissured bark, and a massive trunk capable of growing to diameters approaching 5 feet.

Bullgrass is a large, native, warm season, perennial bunchgrass, growing to 2' to 3' (60 to 90 cm) in height. The leaves are long blades 6" to 14" (15 to 35 cm) long, are folded and have stiff, short hair on the lower surface. The sheath is conspicuously keeled, especially near the base. The membranous ligule is 3/8" to 1" (10 to 25 mm) long and has a narrow, thin, often frayed tip.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

REFERENCE(S)
Allred 1993
Gould 1951
Moir and Carleton 1987
Stuever 1995
Tirmenstein 1988a
USFS 1986

alligator juniper/skunkbush sumac
Juniperus deppeana/Rhus trilobata

JUDE2/RHTR

SYNONYMS

alligator juniper-oneseed juniper-gray oak/skunkbush sumac *(Juniperus deppeana-Juniperus monosperma-Quercus grisea/Rhus trilobata* JUDE2-JUMO-QUGR3/RHTR).

CODES

typic phase 2 31 04 0

KEY CRITERIA

A juniper woodland wherein alligator juniper and oneseed juniper are codominant with a well represented (>5% cover) shrubby understory and true mountain mahogany or desert ceanothus is scarce (<1% cover).

STRUCTURE

Alligator juniper and oneseed juniper are the overstory dominants and major climax species. Gray oak may be a codominant and major or minor climax species. Utah juniper is a minor climax species.

LOCATION

Moderately steep and steep hill and mountain slopes; at elevations of 4,600' to 6,900' (1,400 to 2,100 m) on gravelly or cobbly soils; southern New Mexico in winter-mild climates; Guadalupe Mountains, in the vicinity of Glenwood, NM and adjoining Arizona.

ALSO SEE

Gehlbach 1967, Souders (1985) mapping unit 3967. JUDE2/CEGR is considerably more shrubby and less grassy, but neither habitat type has been well described synecologically. The absence (or accidental occurrence) of twoneedle pinyon helps distinguish JUDE/RHTR.

TREES

Well represented (>5% cover) or abundant (>25% cover)**:**
alligator juniper *(Juniperus deppeana)*
oneseed juniper *(Juniperus monosperma)*
gray oak *(Quercus grisea)*
Utah juniper *(Juniperus osteosperma)*

SHRUBS

Common (>1% cover) or well represented (>5% cover)**:**
skunkbush sumac *(Rhus trilobata)*
fragrant mimosa *(Mimosa borealis)*
featherplume *(Dalea formosa)*
sacahuista *(Nolina microcarpa)*
western honey mesquite *(Prosopis glandulosa)*
walkingstick cactus *(Opuntia spinosior)*
tulip pricklypear *(Opuntia phaeacantha)*
common sotol *(Dasylirion wheeleri)*
green sotol *(Dasylirion leiophyllum)* [Guadalupe Mountains]
Wrights buckwheat *(Eriogonum wrightii)*

HERBS

Well represented (>5% cover)**:**
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
bottlebrush squirrel tail *(Elymus elymoides*)
bluestems *(Schizachyrium* spp.*)*
muhlys *(Muhlenbergia* spp.*)*

BRIEF PLANT ID NOTES

Alligator juniper is a native evergreen, scale-leaved tree with heavy primary branches, distinctive checkered or fissured bark, and a massive trunk capable of growing to diameters approaching 5 feet.

Skunkbush sumac is a native deciduous shrub growing to about 7' (2 m) in height. It has leaflets of three (3/8" to 1-1/4" [10 to 30 mm] long), green and no hairs on upper surface, minutely pubescent on the lower surface; the margin lobed and the terminal leaflet much longer than wide. The small red to orange fruits are covered with short, glandular hairs. When crushed, the leaves give off a pungent (some say, ill-smelling) somewhat "skunky" odor.

SYNONYMY

bottlebrush squirrel tail *(Elymus elymoides = Sitation hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodland)
Elevational Subzone: -1 (warm, dry)
Climate Class: HSM (high sun mild)

REFERENCE(S)

Gehlbach 1967
Moir and Carleton 1986
Souders 1985
Tirmenstein 1988a

Utah juniper/big sagebrush
Juniperus osteosperma/ Artemisia tridentata

JUOS/ARTR2

CODE(S)

typic phase 2 02 02 0

KEY CRITERIA

This plant association has ***big sagebrush** in the understory, and a ***Utah juniper** and one-seed juniper overstory which seldom exceeds 15% canopy cover.

LOCATION

This plant association occurs from northern Arizona and northern New Mexico to SW Colorado, Utah, Nevada and Wyoming. Typically found at elevations between 5,700' to 7,000' (1740-2130 m) on a wide range of slopes from level to steeply sloping piedmont plains. Mean annual precipitation (MAP) = 10-14"/year, much of this as winter snow. Soils often on gullied alluvium.

ALSO SEE

JUMO/ARTR2 is very similar; some of the JUOS communities described in Southern Nevada by Blackburn, Tueller, and Eckert (1969) can probably be assigned to this association. TES mapping unit 111 on Santa Fe National Forest (Gass *et al*. 1983).

TREES

Well represented (>5%), to about 15% cover:
*Utah juniper *(Juniperus osteosperma)*
oneseed juniper *(Juniperus monosperma)*
[occasionally mixed in]

SHRUBS

Well represented (>5%):
***big sagebrush** *(Artemisia tridentata)*
black sagebrush *(Artemisia nova)*
fourwing saltbush *(Atriplex canescens)*
Stansbury cliffrose*(Purshia stansburyiana)*
broom snakeweed *(Guiterrizia sarothae)*
cholla & pricklypear *(Opuntia* spp.)
pinque hymenoxys*(Hymenoxys richardsonii)*

HERBS

Well-represented (>5%) to abundant (>25%), especially grasses:
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
sideoats grama *(Bouteloua curtipendula)*
galleta *(Hilaria jamesii)*
western wheatgrass *(Pascopyrum smithii)*
bottlebrush squirreltail *(Elymus elymoides)*
Indian ricegrass *(Oryzopsis hymenoides)*
threeawn *(Aristida* spp.)

BRIEF PLANT ID NOTES

Recognizing the variety of big sagebrush is important for determining the browse value for elk and deer. Basin big sagebrush *(A. t.* var. *tridentata)* has an uneven top, a single main stem, and gray-green foliage. Mountain big sagebrush *(A. t.* var. *vaseyana)* has a flat top, multiple main stems, and blue green foliage. Wyoming big sagebrush *(A. t.* var. *wyomingensis)* has a round top, multiple main stems and gray-green foliage.

SYNONOMY

black sagebrush *(Artemisia nova) =*
low sagebrush *(A. arbuscula* var. *nova)*
Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: LSC (low sun cold)

FIRE ECOLOGY

Big sagebrush is easily killed by fire and does not resprout; however, it does rapidly reinvade a site if soil stored or off-site seed is available. (Tirmenstein 1986). Mountain big sagebrush is the most flammable and Wyoming big sagebrush is the least flammable of the subspecies discussed above.

REVEGETATION CONSIDERATIONS

Big sagebrush, a good winter forage plant, can be successfully drilled or broadcast seeded. The "Hobble Creek" selection of mountain big sagebrush is available for lower elevations (Welch *et al*. 1986). Black sagebrush can be a nutritious winter browse for game. The "Pine Valley Ridge" superior strain (Welch *et al*. 1994) can be strip seeded with a grass/forb mixture (Rita Suminski, 1996, personal communication).

COMMENTS

Livestock grazing can result in higher density or cover of broom snakeweed, pingue, blue grama, big sagebrush, or rubber rabbitbrush.

At these lower elevations where range conditions are overgrazed or in poor ecological health, big sagebrush can invade mesic areas and act as a pheatophyte, drying up smaller springs, seeps, and creeks in a relatively short time (Blaisdell *et al*. 1982; Rita Suminski, 1996, personal communication).

Determining which variety of big sagebrush is present is important for wildlife management. *A. t*. var. *tridentata* is generally poor browse, although *A. t*. var. *wyomingenis* provides good winter browse for elk and deer and *A. t*. var. *vaseyana* provides good summer browse.

REFERENCE(S)

Blackburn, Tueller, and Eckert 1969
Blaisdell *et al*. 1982
Bradley 1986a
Gass *et al*. 1983
Tirmenstein 1986
USFS 1987a
Welch *et al*. 1986, 1994

Utah juniper/blue grama
Juniperus osteosperma/
Bouteloua gracilis

JUOS/BOGR2

SYNONYMS

Juniperus monosperma/Bouteloua gracilis, Juniperus osteosperma phase (USFS 1986).

CODE(S)

typic phase	2 02 32 0
cliffrose (PUST) phase	2 02 32 1

KEY CRITERIA

A juniper savanna with a rich understory of grasses, usually including blue grama *(Bouteloua gracilis)*. Utah juniper is the dominant tree, although pinyon pine may be present, but is usually confined to microsites.

STRUCTURE

This type can support a heavy cover of juniper trees to the near exclusion of herbaceous understory. Likewise, this type can support grass, particularly in absence or weak expression of trees. Early seral situations should provide moderate amounts of forage for cattle, while late seral stages offer low amounts of forage for cattle.

LOCATION

Primarily known from central and northern Arizona. Occurs in valleys and on elevated plains and piedmont alluvial fans. Elevations range from 5,000' - 6,000' (1525 - 1825 m).

ADJACENT PLANT ASSOCIATIONS

On more mesic toe slopes, JUOS/BOGR2 may adjoin the PIED/BOGR2 hillslope phase.

ALSO SEE

JUMO/BOGR2 is very similar to JUOS/BOGR2, from USFS 1987a. Much data are needed before the two habitat types are better distinguished. At present, separation of JUMO/BOGR2 & JUOS/BOGR2 is mostly geographical. JUMO/BOGR2 is generally centered in HSC climates. Also Baxter 1977.

TREES & LIFE HISTORY TRAIT

Well represented (>5%):
Utah juniper *(Juniperus osteosperma)* C

SHRUBS

Scarce (<1%) [typic phase] or well represented (>5%) [PUST phase]:
small soapweed *(Yucca glauca)*
Stansbury cliffrose*(Purshia stansburyiana)*
red barberry *(Mahonia haematocarpa)*
pale wolfberry *(Lycium pallidum)*
Wrights buckwheat *(Eriogonum wrightii)*

HERBS

Well represented (>5%) to abundant (>25%), especially grasses:
blue grama *(Bouteloua gracilis)*
black grama *(Bouteloua eriopoda)*
sideoats grama *(Bouteloua curtipendula)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
threeawn *(Aristida* spp.)
common wolfstail *(Lycurus pheloides)*
ring muhly *(Muhlenbergia torreyi)*
bottlebrush squirrel tail *(Elymus elymoides)*
New Mexico needlegrass *(Stipa neomexicana)*
prairie junegrass *(Koeleria macrantha)*
western wheatgrass *(Pascopyrum smithii)*

BRIEF PLANT ID NOTES

Utah juniper usually has both male and female cones on the same tree, unlike other junipers in the area. The twisted trunk of the Utah juniper is usually a single stem, but oneseed juniper has multiple stems.

The inflorescence or "flag" can be used to distinguish blue grama from hairy grama

(Bouteloua hirsuta). On blue grama, the flag is curved and the terminal awn is shorter than the width of the flag. This awn is longer on hairy grama, which also has straight flags.

SYNONYMY

red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
Stansbury cliffrose*(Purshia stansburyiana = Cowania stansburyiana = C. mexicana)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSC (high sun cold)

PHASES

JUOS/BOGR2 has two phases, the typic phase and the more shrubby cliffrose phase. The JUMO/BOGR2, JUOS phase (mentioned in USFS 1986) is treated as JUOS/BOGR2, typic phase in this publication.

FIRE ECOLOGY

Burning in this site usually encourages grasses, although the lack of continuous fine fuels may limit the spread of fires except under extreme conditions. When blue grama is dormant (early spring, driest part of summer) it is less likely to be damaged by fire. Reestablishment of blue grama occurs through rhizomes (Tirmenstein 1987b). A 3 to 4 month rest from grazing is recommended for burned sites (Tirmenstein 1987b).

REFORESTATION

No information on reforestation is available in this type. Most forest management activities have been focused toward reducing existing trees, rather than planting them. Due to fire exclusion and grazing practices of at least the past century, many sites now support more trees than they did prior to European settlement. Mechanical site preparation may encourage juniper regeneration by providing seed beds and reducing grass competition.

REVEGETATION CONSIDERATIONS

Following distubance, revegetation on this site can be slow.

COMMENTS

The cool season component of this association is often absent or weakly expressed as a result of yearlong or winter livestock grazing over many years. Well represented populations of broom snakeweed often indicate such grazing history.

REFERENCE(S)

Baxter 1977
Tirmenstein 1986
Tirmenstein 1987b
USFS 1987b
USFS 1986

Utah juniper/tobosagrass JUOS/HIMU
Juniperus osteosperma/Hilaria mutica

CODE(S)

mesquite (PRVE) phase	2 02 33 0
Arizona pinyon (PIFA) phase	2 02 33 1

KEY CRITERIA

A juniper savannah, often on heavy clay soils. ***Tobosagrass, *curlymesquite**, and/or ***panic grass** are present among an abundant cover of herbs. Juniper trees dominate the overstory, but rarely reach over 10% cover. Arizona pinyon pine may be present in the PIFA phase, but is usually only occasional or a minor climax species.

STRUCTURE

Grasses and shrubs generally increase as tree cover is removed. Tree cover rarely exceeds 10% and opportunities for firewood are limited.

LOCATION

Widespread south of the Mogollon Rim, this plant association is typically found on elevated or valley plains, from 4,300' - 5,900' (1315 - 1800 M). Soils generally have a heavy clay content. Mean annual precipitation (MAP) is approx. 17-18"/year (to 20"/yr in the PIFA phase). Mean annual air temperature (MAAT) is 55-61 degrees F.

ALSO SEE

TES mapping units 3181, 3187, & 3700 (PIFA phase) on the Globe Ranger District (1984); 3832 on the Glenwood Ranger District (1985). The various subseries of these TES mapping units include JUMO-PRGLT-HIBE-HEAN, JUOS-JUMO-PRVE-BOHI-HIBE,JUOS-HIBE-PAOB, and JUMO-JUOS-PRGLG.

TREES

Well represented (5-10% canopy cover):
Utah juniper *(Juniperus osteosperma)*
redberry juniper *(Juniperus erythrocarpa)*
Arizona pinyon *(Pinus fallax)* [PIFA phase]

SHRUBS

Common (>1%) or well represented (>5%) [especially on heavily grazed sites]:
mesquite *(Prosopsis* spp.) [varieties depend on geography]
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
broom snakeweed *(Gutierrezia sarothrae)*
sacahuista *(Nolina microcarpa)*
catclaw acacia *(Acacia greggii)*
tulip pricklypear *(Opuntia phaeacantha)*
walkingstick cactus *(Opuntia spinosior)*
Whipple cholla *(Opuntia whipplei)*
littleleaf ratany *(Krameria erecta)*

HERBS

Abundant (>25%) to luxuriant (>50%):
*tobosagrass *(Hilaria mutica)*
*curlymesquite *(Hilaria belangeri)*
*obtuse panicgrass *(Panicum obtusum)*
sideoats grama *(Bouteloua curtipendula)*
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
threeawn *(Aristida* spp.)
and numerous annuals including:
common sunflower *(Helianthus annuus)*
foxtail brome *(Bromus rubens)*
mucronate sprangletop *(Leptochloa mucronata)*
witchgrass *(Panicum capillare)*
slender goldenweed *(Macraeranthera gracilis)*

BRIEF PLANT ID NOTES

Most of the leaves of the tobosagrass are basal, stiff, harsh, and hairless, and are up to 6 inches long. Flowering spikes are erect and straw to purplish in color. This native, warm season grass has rhizomes and forms sod (Uchytil 1988b)

SYNONYMY

littleleaf ratany *(Krameria erecta = K. parvifolia)*
slender goldenweed *(Macraeranthera gracilis = Haplopappus gracilis)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry), 0 (typic) [PIFA phase]
Climate class: LSM (low sun mild) HSM (high sun mild)

PHASES

There are two phases, the Arizona pinyon phase occurs in low sun mild (LSM) climates, and has Arizona pinyon in the overstory. The mesquite phase is drier.

FIRE ECOLOGY

No specific information was available for this plant association. For tobosagrass, fires generally rejuvenate the grass, especially when followed by precipitation. In this upland, relatively dry setting, tobosagrass may not form dense sod capable of carrying a fire (Uchytil 1988b).

REFORESTATION

Selective cutting tends to favor juniper regeneration, but seed tree or clear cuts favor grass and shrubs.

REVEGETATION CONSIDERATIONS

Natural revegetation is slow to moderate following disturbance.

COMMENTS

Historical photos suggest that valleys and mesa tops were once steppic and free of junipers or strong shrub cover. Since about 1880 a combination of livestock grazing, fire suppression, and soil erosion are among the factors producing shrub and juniper increases. Herbs most tolerant of heavy grazing include curlymesquite, tobosagrass, and annuals. Soils supporting this plant association tend to be subject to severe erosion if grazing levels are too high (USFS 1987b).

REFERENCE(S)

Souders 1985
TES A-S NF, 1987
Uchytil 1988b
USFS 1987b

Utah juniper-oneseed juniper/sparse c.t. Juniperus osteosperma-Juniperus monosperma/sparse

JUOS-JUMO/sparse

SYNONYMS
Juniper/sparse c.t. (h.t.)

CODE(S)
typic phase 2 02 50 0

KEY CRITERIA
Understory is sparse, although annual plants may be well represented. Juniper overstory is well represented to abundant. Existing plants may be on pedestals, providing evidence of recent erosion.

STRUCTURE
This community type may be an advanced successional stage from several plant associations, as well as a prolonged successional stage (disclimax) under current soil and management conditions. Juniper/sparse may be a "badland" plant association, as well as on special parent materials such as gypsum. Soil and landform features are critical in helping distinguish seral or climax (potential) expressions of this association. Herbage production rapidly increases as tree cover decreases below 10 square feet/acre. As tree cover increases, herbage production is significantly reduced. Decreases in site productivity can be expected with extended exposure to wind and water erosion (Baker *et al*. 1995).

LOCATION
Widespread in New Mexico and Arizona. Commonly occurs between 5,000' - 6400' (1525 - 1950 m) on a wide variety of soils and parent materials, often adjoining grasslands of valley plains or piedmont slopes. Can occur on special sites such as erosional badlands or gypsum soils. Mean annual precipitation (MAP) = 12-16"/yr.

ALSO SEE
JUMO/BOGR2 when perennial herbs are common. Johnsen (1962); Baxter (1977); Dalen and Snyder (1987).

TREES
Well represented (>5%) to abundant (>25%):
Utah juniper *(Juniperus osteosperma)*
oneseed juniper *(Juniperus monosperma)*

SHRUBS
Scarce (<1%).

HERBS
Perennial herbs are scarce, annuals may be common to well represented or even abundant. See JUMO/BOGR for herb list of likely species that may be present.

BRIEF PLANT ID NOTES
Utah juniper usually has both male and female cones on the same tree, although this trait is uncommon for other junipers in the area. The twisted trunk of the Utah juniper is usually a single stem, unlike oneseed juniper with multiple stems.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: varies

FIRE ECOLOGY
Fires are infrequent due to the lack of surface fuels to enable most fire spread. Under extreme conditions (drought and wind), crown fires are possible. Prescribed burning is extremely difficult due to the very narrow

window for these conditions, and then the difficulty of control during these conditions. Utah juniper is usually killed when 60% or more of the tree crown is scorched. Low intensity fires tend to kill trees under 3-4 feet tall (Tirmenstein 1986). Likewise, oneseed juniper is also susceptible to fire and is not considered a climax species in grasslands subject to frequent fires (Tirmenstein 1989).

REFORESTATION

Both junipers naturally regenerate from seed. Sprouting is not an important regeneration method.

REVEGETATION CONSIDERATIONS

In many cases, removal of juniper alone does little to increase long term forage potential. Control of grazing with seeding may be necessary for sites to develop a grass component.

COMMENTS

Utah and oneseed juniper "berries" are important food sources for many birds and small mammals (Tirmenstein 1989a, 1986). The foliage of oneseed juniper can be significant for mule deer and pronghorn diets (Tirmenstein 1989a).

REFERENCE(S)

Baker *et al*. 1995
Baxter 1977
Clary *et al*. 1974
Dalen and Snyder 1987
Johnsen 1962
Tirmenstein 1986, 1989a
USFS 1987a
USFS 1987b
USFS 1986

oneseed juniper/lecheguilla
Juniperus monosperma/ Agave lechuguilla

JUMO/AGLE

CODE(S)
typic phase 2 01 42 0

KEY CRITERIA
An open cover of **oneseed juniper** with a shrubby understory, consisting primarily of **lecheguilla**.

STRUCTURE
Gelbach (1967) observed that oneseed juniper was most important in the shrub stratum, and does not attain prominence in the tree stratum.

LOCATION
Known from the Guadalupe Mountains in southern New Mexico, this association occurs on hot, dry limestone slopes along draws and gullies, 4,000' - 4,600' (1225 -1400 m).

ALSO SEE
Similar to JUMO/NOMI-AGLE, but more shrubby (dominated by lecheguilla) and less grassy. The *Dasylirion-Agave* formation (Gelbach 1967) is similar, but lacks juniper.

TREES
Open cover (3 - 10%):
oneseed juniper *(Juniperus monosperma)*

SHRUBS
Well represented (>5%), dominated by evergreen rosette species:
*lecheguilla *(Agave lechuguilla)*
green sotol *(Dasylirion leiophyllum)*
sacahuista *(Nolina microcarpa)*
yucca *(Yucca* spp.)
other species may include:
tree cholla *(Opuntia imbricata)*
skeletonleaf goldeneye *(Viguiera stenoloba)*

HERBS
Usually poorly represented (<5%):
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
hairy woollygrass *(Erioneuron pilosum)*
slim tridens *(Tridens muticus)*
bush muhly *(Muhlenbergia porteri)*
curlyleaf muhly *(Muhlenbergia setifolia)*
plains bristlegrass *(Setaria macrostachya)*

BRIEF PLANT ID NOTES
The lecheguilla primarily consists of a basal rosette of semisucculent, banana-shaped leaves, generally less than 16" long, with spines along the leaf margin that point to the base of the plant. The terminal spine is often longer than one inch. It grows in colonies, often forming dense mats.

SYNONOMY
hairy woollygrass *(Erioneuron pilosum = Tridens pilosus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 3 (grasslands)
Elevational Subzone: +1 (cool, moist)
Climate class: HSM (high sun mild)

COMMENTS
Possibly derived from JUMO/NOMI-AGLE plant association or desert grassland as a result of livestock grazing, soil erosion, or climatic change.

REFERENCE(S)
Gehlbach 1967
Moir & Carleton 1987
Stuever 1995
USFS 1986
Van Devender *et al*. 1984

oneseed juniper/sand bluestem Juniperus monosperma/ Andropogon hallii

JUMO/ANHA

CODE(S)

typic phase 2 01 34 0

KEY CRITERIA

This juniper woodland has a grassy understory which includes ***sand bluestem** and/or ***sandhill muhly**. The shrub ***broom dalea *(Psorothamnus scoparius)*** is also present.

STRUCTURE

Plant growth may be limited if sandy soils have low moisture holding capacity and limited fertility. Little documentation is available for structure and productivity of this association.

LOCATION

Occurs locally in the landscape in central and northern New Mexico on valley plains with deep, sandy soils. Typical soil is Typic Ustipsamments.

ALSO SEE

See TES mapping unit 143 & 144 (Carson NF, Edwards *et al*. 1987). If pinyon is regenerating, see PIED/ANHA. This association may be similar to JUMO/MUPU mentioned in Moir and Carleton (1987).

TREES

Well represented (>5%):
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Usually scarce (<1%), but sometimes well represented (>5%):
sand sagebrush *(Artemisia filifolia)*
big sagebrush *(Artemisia tridentata)* [LSC climate]
soaptree yucca *(Yucca elata)*
*broom dalea *(Psorothamnus scoparius)*
skunkbush sumac *(Rhus trilobata)*
rabbitbrush *(Chrysothamnus* spp.)

HERBS

Well represented (>5%):
*sand bluestem *(Andropogon hallii)*
*sandhill muhly *(Muhlenbergia pungens)*
little bluestem *(Schizachyrium scoparium)*
blue grama *(Bouteloua gracilis)*
sand dropseed *(Sporobolus cryptandrus)*
spike dropseed *(Sporobolus contractus)*
spreading wallflower *(Erysium repandum)*
Indian ricegrass *(Oryzopsis hymenoides)*

BRIEF PLANT ID NOTES

Similar to big bluestem (considered the same species by some), sand bluestem has two to five finger-like racemes with yellowish hairs on the rachis and pedicels.

SYNONOMY

little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*.
broom dalea *(Psorothamnus scoparius = Dalea scoparia)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSC (high sun cold)
LSC (low sun cold)

FIRE ECOLOGY

No fire ecology information specific to this plant association is available. However, warm season perennial grasses such as sand bluestem are most susceptible to fire during the growing season, and generally recover

very rapidly after fires. Where prescribed burning is considered for unstable sand dune areas, burning may be best in the spring, prior to grass growth, to minimize exposure of bare soils. Unless grasses are abundant, prescribed burning may be difficult due to lack of fine fuels for fire spread.

REFERENCE(S)

Edwards *et al*. 1987
Moir & Carleton 1987
Stuever 1995
Uchytil 1988a
USFS 1987a
USFS 1986

oneseed juniper/ Bigelow sagebrush Juniperus monosperma/ Artemisia bigelovii

CODE(S)

typic phase 2 01 35 0

KEY

CRITERIA

This plant association has ***Bigelow sagebrush** in the understory, and a ***oneseed juniper** overstory which seldom exceeds 10% canopy cover. Twoneedle pinyon may be accidental.

STRUCTURE

Very limited information is available for this plant association.

LOCATION

This plant association occurs locally in northern Arizona and possibly northern New Mexico, southern Utah, and southwestern Colorado. Found on limestone mesas and hillslopes, on very shallow rocky soils (Lithic Ustochrepts and Lithic Ustorthents) from 5,000' to 7,000' (1520 - 2130 m). Mean annual precipitation (MAP) is about 14"/year.

ALSO SEE

PIED/rockland.

TREES

Well represented (>5%), but <10%:

oneseed juniper *(Juniperus monosperma)* C

SHRUBS

Well represented (>5%):

*Bigelow sagebrush *(Artemisia bigelovii)*
fourwing saltbush *(Atriplex canescens)*
winterfat *(Krascheninnikovia lanata)*
Fremont mahonia *(Mahonia fremontii)*
Mormon tea *(Ephedra* spp.)

HERBS

Well-represented (>5%):

blue grama *(Bouteloua gracilis)*
black grama *(Bouteloua eriopoda)*
threeawn *(Aristida* spp.)
common wolfstail *(Lycurus pheloides)*
needleandthread *(Stipa comata)*
New Mexico needlegrass *(Stipa neomexicana)*
Rocky Mountain zinnia *(Zinnia grandiflora)*

BRIEF PLANT ID NOTES

Bigelow sagebrush is a spreading shrub generally about a foot tall. The center lobe of the three-lobed, wedge shaped leaf is larger than the side lobes. Hairs on the leaves gives this sagebrush a silvery appearance.

SYNONOMY

winterfat *(Krascheninnikovia lanata = Ceratoides lanata = Eurotia lanata)*
Fremont mahonia *(Mahonia fremontii = Berberis fremontii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: LSC (low sun cold)

REVEGETATION CONSIDERATIONS

Winterfat is difficult to cultivate. Many seed sources available for winterfat are from other regions where a lower elevation variety occurs, and may not be suitable for this plant association (Suminski, 1996, personal communication). If planting winterfat, try to use local seed.

COMMENTS

Good winter range for elk and deer. Winterfat is a key livestock and elk forage plant, but is difficult to plant or seed successfully.

REFERENCE(S)

USFS 1987a

oneseed juniper/big sagebrush
Juniperus monosperma/ Artemisia tridentata

JUMO/ARTR2

CODE(S)

typic phase 2 01 04 0

KEY CRITERIA

This plant association has ***big sagebrush** in the understory, and a ***oneseed juniper** overstory which seldom exceeds 10% canopy cover.

LOCATION

This plant association is found in northern New Mexico on elevated and piedmont plains from 6,600' to 6,800' (2010-2070 m). It may occur on a wide variety of soils including calcareous Typic Ustochrepts and Typic Haplustalfs (consult TES reports and verify on-site soils). Mean annual precipitation (MAP) is about 14"/year.

ADJACENT PLANT ASSOCIATIONS

May adjoin PIED/ARTR2 on more mesic sites, and grasslands on more xeric sites.

ALSO SEE

JUOS/ARTR2; *Juniperus monosperma/Artemisia tridentata/Hilaria jamesii-Sporobolus crytandrus* plant community (Francis 1986); TES mapping units 143 on Carson National Forest (Edwards *et al*. 1987); TES mapping unit 111 on Santa Fe National Forest (Gass *et al*. 1983); *Juniperus osteosperma-Pinus edulis-Artemisia tridentata* association (Warren *et al*. 1982).

TREES

Well represented (>5%), to about 10% cover:
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Well represented (>5%):
*big sagebrush *(Artemisia tridentata)*
broom snakeweed *(Gutierrezia sarothae)*
plains pricklypear *(Opuntia polyacantha)*
fourwing saltbush *(Atriplex canescens)*
pinque *(Hymenoxys richardsonii)*
rubber rabbitbrush *(Chrysothamnus nauseosus)*

HERBS

Well-represented (>5%):
galleta *(Hilaria jamesii)*
sand dropseed *(Sporobolus cryptandrus)*
alkali sacaton *(Sporobolus airoides)*
Indian ricegrass *(Oryzopsis hymenoides)*
bottlebrush squirreltail *(Elymus elymoides)*
western wheatgrass *(Pascopyrum smithii)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
Fendler threeawn *(Aristida purpurea* var. *fendleriana)*
blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
sideoats grama *(Bouteloua curtipendula)*
James buckwheat *(Eriogonum jamesii)*
New Mexico needlegrass *(Stipa neomexicana)*

BRIEF PLANT ID NOTES

Recognizing the variety of big sagebrush is important for determining the browse value for elk and deer. Basin big sagebrush *(A. t.* var. *tridentata)* has an uneven top, a single main stem, and gray-green foliage. Mountain big sagebrush *(A. t.* var. *vaseyana)* has a flat top, multiple main stems, and blue green foliage. Wyoming big sagebrush *(A. t.* var. *wyomingensis)* has a round top, multiple main stems, and gray-green foliage.

SYNONOMY

bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*
Fendler threeawn = red threeawn *(Aristida purpurea* var. *longiseta = A. longiseta)*
Fendler threeawn *(Aristida purpurea* var. *fendleriana = Aristida fendleriana)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: LSC (low sun cold)

FIRE ECOLOGY

Big sagebrush is easily killed by fire and does not resprout; however, it can reinvade a site if soil stored or off-site seed is available. Mountain big sagebrush is the most flammable and Wyoming big sagebrush is the least flammable of the subspecies discussed above. Wildfire or prescribed burning can be detrimental to mule deer winter range by reducing big sagebrush which is a prime browse species (Suminski 1993).

COMMENTS

Alkali sacaton and western wheatgrass may be indicative of clayey soils (Alfisols), whereas sideoats grama and other grasses may suggest non-clayey soils (Inceptisols or Entisols). Livestock grazing can result in higher density or cover of broom snakeweed, pingue, blue grama or rubber rabbitbrush.

REFERENCE(S)

Bradley 1986a
Edwards *et al*. 1987
Francis 1986
Gass *et al*. 1983
Moir & Carleton 1987
Suminski 1993
USFS 1987a

oneseed juniper/sideoats grama
Juniperus monosperma/ Bouteloua curtipendula

JUMO/BOCU

CODE(S)

typic phase	2 01 01 0
sacahuista (NOMI) phase	2 01 01 1

KEY CRITERIA

A juniper woodland, often on steep, rocky slopes. ***Oneseed juniper** is the dominant tree, although pinyon pine may be present, but is usually only occasional or minor climax species. ***Sideoats grama** *(Bouteloua curtipendula)* is common.

LOCATION

From southern New Mexico and southeastern Arizona (NOMI phase) into southern Colorado (typic phase). Typically on steep, colluvial slopes of escarpments, and hill or mountainsides with > 15% slope. Soils, from a wide variety of parent materials, are often stony or rocky, and may be interrupted by rock outcrops. Elevations range from 4,900' - 6,400' (1500 - 1950 m). Mean annual precipitation (MAP) is approx. 15-19"/year. Mean annual air temperature (MAAT) is 55-57 degrees F.

ALSO SEE

Scarp woodland on steep, rocky slopes; JUMO/BOGR2 on gentle slopes where sedimentation tends to be despositional; TES mapping units 224, 412, 432 for Apache-Sitgreaves National Forests (1987).

TREES & LIFE HISTORY TRAITS

Well represented (>5%):

oneseed juniper *(Juniperus monosperma)*	C
gray oak *(Quercus grisea)* [s. AZ, s. NM]	c
twoneedle pinyon *(Pinus edulis)* [regen is minor]	c

SHRUBS

Common (>1%) to well represented (>5%):

typic phase

skunkbush sumac *(Rhus trilobata)*
big sagebrush *(Artemisia tridentata)* [<1%]
true mountain mahogany *(Cercocarpus montanus)*
wavyleaf oak *(Quercus Xpauciloba)*
broom snakeweed *(Gutierrezia sarothrae)*
tree cholla *(Opuntia imbricata)*

sacahuista (NOMI) phase

skunkbush sumac *(Rhus trilobata)*
sacahuista *(Nolina microcarpa)*
desert ceanothus*(Ceanothus greggii)*
common sotol *(Dasylirion wheeleri)*
banana yucca *(Yucca baccata)*
tulip pricklypear *(Opuntia phaeacantha)*
walkingstick cactus *(Opuntia spinosior)*
broom snakeweed *(Gutierrezia sarothrae)*
Wrights buckwheat *(Eriogonum wrightii)*
gray oak *(Quercus grisea)*
gray oak intergrades with shrub live oak *(Quercus grisea X turbinella)*

Herbs

Common (>1%) to abundant (>25%):
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
bottlebrush squirrel tail *(Elymus elymoides)*
common wolfstail *(Lycurus pheloides)*
needlegrass *(Stipa* spp.)

typic phase:

galleta *(Hilaria jamesii)*
New Mexico muhly *(Muhlenbergia pauciflora)*
little bluestem *(Schizachyrium scoparium)*

Colorado four o'clock *(Mirabalis multiflora)*
James buckwheat *(Eriogonum jamesii)*
trailing fleabane *(Erigeron flagellaris)*
sacahuista (NOMI) phase:
bullgrass *(Muhlenbergia emersleyi)*
Herter cane bluestem *(Bothriochloa barbinodis)*
Texas bluestem *(Schizachyrium cirratum)*
single threeawn *(Aristida orcuttiana)*
plains lovegrass *(Eragrostis intermedia)*
green sprangletop *(Leptochloa dubia)*
purple grama *(Bouteloua radicosa)*
numerous forbs

BRIEF PLANT ID NOTES

Sideoats grama is easy to recognize by it's slender, zig-zag flower stalk or rachis which supports 20-60 small spikes, usually all hanging down on the same side. When the spikes have dropped, sideoats grama can be confused with tobosa *(Hilaria mutica)* which also has a wavy rachis, but is less robust and forms short mats.

SYNONYMY

wavyleaf oak *(Quercus* X *pauciloba = Quercus undulata)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*
trailing fleabane *(Erigeron flagellaris = E. nudiflorus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSM (high sun mild)

PHASES

The JUMO/BOCU, NOMI phase has been identified on the Clifton RD, and in SW New Mexico. The JUMO/BOCU, typic phase is known from the Jemez Mountains and southern Colorado, but is probably widespread.

FIRE ECOLOGY

Although no documentation was available for fire response specific to this plant association, responses to fire by sideoats grama appear to be varied and involve many variables (for more information, see Tirmenstein 1987b).

COMMENTS

Management activities may be limited by high erosion potential on colluvial slopes.

REFERENCE(S)

Barnes 1987
Johnston 1987
Stuever 1995
Tirmenstein 1987b
TES A-S NF, 1987
USFS 1987a
USFS 1987b

oneseed juniper/blue grama
Juniperus monosperma/ Bouteloua gracilis

JUMO/BOGR2

CODE(S)

typic phase 2 01 02 0

KEY CRITERIA

A juniper savanna with a rich understory of grasses, usually including blue grama *(Bouteloua gracilis)*. ***Oneseed juniper** is the dominant tree, although pinyon pine may be present, but is usually confined to microsites. Sideoats grama *(Bouteloua curtipendula)* is scarce or absent. Twoneedle pinyon *(Pinus edulis)* is accidental.

STRUCTURE

Stand conditions can vary from open savannas to dense tree cover. Grasses decrease with an increase in tree density.

LOCATION

Widespread in New Mexico, Arizona, and southern Colorado. Occurs in valley plains, piedmont alluvial fans. Elevations range from 5,500' - 7,000' (1675 - 2130 m). Occurs on a wide variety of soil and parent materials. Mean annual precipitation (MAP) is approx. 14-16"/year.

ALSO SEE

JUMO/BOGR2 is very similar to JUOS/BOGR2, from USFS 1987a. Much data are needed before the two habitat types are better distinquished. At present, separation of JUMO/BOGR2 & JUOS/BOGR2 is mostly geographical.

JUMO/BOGR2 and JUMO/BOCU may be hard to differentiate. Location on the slope may be more reliable than dominance of sideoats grama which can be altered under various grazing pressures. JUMO/BOGR2 occurs on alluvial settings where soil is being deposited (i.e. lower slopes, toe slopes) while JUMOBOCU occurs on more colluvial upper slopes.

Dick-Peddie, *et al*. 1984; Francis 1986; Johnsen 1962; TES mapping units 143 & 168 on the Carson National Forest (Edwards *et al*. 1987), 112 on the Santa Fe National Forest (Gass *et al*. 1983), 14 on the Smokey Bear Ranger District (USFS 1985), and 41, 43, and 44 on the Heber Ranger District (Nelson & Redders 1982).

TREES

Well represented (>5%):
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Scarce (<1%); however on grazed ranges shrubs may be well represented and may include:
broom snakeweed *(Gutierrezia sarothrae)*
rabbitbrush *(Chrysothamnus* spp.)
cholla & pricklypear *(Opuntia spp.)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)* [depending on geography]
on relict sites (Baxter 1977):
sacahuista *(Nolina microcarpa)*

HERBS

Abundant (>25%) or luxuriant (>50%):
blue grama *(Bouteloua gracilis)*
black grama *(Bouteloua eriopoda)*
galleta *(Hilaria jamesii)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
Fendler threeawn *(Aristida purpurea* var. *fendleriana)*
sand dropseed *(Sporobolus cryptandrus)*
bottlebrush squirrel tail *(Elymus elymoides)*
muttongrass *(Poa fendleriana)*
prairie junegrass *(Koelaria macrantha)*
needlegrass *(Stipa* sp.)

ring muhly *(Muhlenbergia torreyi)*
bastardsage *(Eriogonum wrightii)*
fringed sagewort *(Artemisia frigida)*
globemallow *(Sphaeralcea* spp.)
rose heath *(Chaetopappa ericoides)*
pinque hymenoxys*(Hymenoxys richardsonii)*
slimflower scurfpea*(Psoralidium tenuiflorum)*

BRIEF PLANT ID NOTES

The inflorescence or "flag" can be used to distinguish blue grama from hairy grama *(Bouteloua hirsuta)*. On blue grama, the flag is curved and the terminal awn is shorter than the width of the flag. This awn is longer on hairy grama, which also has straight flags.

SYNONYMY

mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*
slimflower scurfpea*(Psoralidium tenuiflorum = Psoralea tenuiflora)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:	4 (woodlands)
Elevational Subzone:	-1 (warm, dry)
Climate class:	LSC (low sun cold)
	HSC (high sun cold)
	HSM (high sun mild)

PHASES

The JUMO/BOGR2, JUOS phase (mentioned in USFS 1986) is treated as JUOS/BOGR2 in this publication. This leaves one phase, the typic phase, for this association at this time. Moir & Carleton (1987), however, place a JUMO/BOGR2, QUTU phase in the HSM climate and cite TES mapping unit 120 on the Alma Mesa and Strayhorse (Clifton RD) allotments TES report as a reference. Below the Mogollon Rim, this association is probably more correctly called JUER/BOGR2 to reflect the dominance of redberry juniper rather than oneseed juniper.

FIRE ECOLOGY

The lack of continuous fine fuels may limit the spread of fires except under extreme conditions. Francis (1986) reported 75% bare soils in stands he inventoried. When blue grama is dormant (early spring, driest part of summer), it is less likely to be damaged by fires. Reestablishment of blue grama occurs through rhizomes (Tirmenstein 1987b). A 3 to 4 month rest from grazing is recommended for burned sites (Tirmenstein 1987b).

COMMENTS

On some sites, tree densities may have increased in this century due to fire exclusion. Johnsen (1962) suggests a combination of grass fires and competition from grasses are necessary to inhibit juniper establishment. Blue grama may be more resistant to this juniper "invasion" than other grass species.

REFERENCE(S)

Dick-Peddie*et al*. 1984
Donart *et al*. 1978 (GG4a)
Edwards *et al*. 1987
Francis 1986
Gass *et al*. 1983
Johnsen 1962
Moir & Carleton 1987
Nelson & Redders 1982
New Mexico Environ. Inst. 1971
Tirmenstein 1987b
USFS 1987a
USFS 1986
USFS 1985, TES Smokey Bear RD

oneseed juniper/ Rabbitbrush-Apacheplume
Juniperus monosperma/Chrysothamnus nauseosus-Fallugia paradoxa

JUMO/CHNA2-FAPA

CODE(S)

typic phase	2 01 33 1
big sagebrush (ARTR2) phase	2 01 33 2
gray oak (QUGR3) phase	2 01 33 3

KEY CRITERIA

***Rubber rabbitbrush** and/or ***Apacheplume** are abundant along washes, streamsides and terraces. Trees present include ***oneseed juniper**, rocky mountain juniper, and in northern Arizona, Utah juniper. An infrequent or occasional narrowleaf cottonwood may be present. In HSM (mild w/ summer moisture) climates, gray oak may also be occasional.

STRUCTURE

Disturbances such as periodic flooding, arroyo cutting, and sustained livestock grazing can weaken the tree and perennial grass components and increase the importance of shrubs and annuals. Several years after disturbance, forage values are generally high due to abundance of palatable shrubs.

LOCATION

Widespread geographically, but often occurs very locally in the landscape in steamsides and river terraces of intermittent washes. Often between 4,300' - 6,500' (1315 - 1980m). Common soils include Typic Ustifluvents, Fluventic Haplustolls, and Fluventic Ustochrepts (site specific determination of soils may be required). The soils are often cut by gullies and arroyos.

ADJACENT PLANT ASSOCIATIONS

May be adjacent to a wide variety of upland pinyon-juniper plant associations.

ALSO SEE

Shrub riparian in Dick-Peddie *et al*. (1984); *Chrysothamnus nauseous* series if trees are scarce (Moir 1983). TES mapping units 34 & 23 (LSC) for the Carson National Forest (Edwards *et al*. 1987) and TES mapping unit 3040 for Glenwood Ranger District (Souders 1985); TES mapping unit 58 for the Apache-Sitgreaves National Forests (USFS 1987). If cottonwood are common, see riparian forests. If pinyon is common, see PIED/CHNA2-FAPA.

TREES

Common (>1%) or well represented (>5%):
*oneseed juniper *(Juniperus monosperma)*
Rocky mountain juniper *(Juniperus scopulorum)*
Utah juniper *(Juniperus osteosperma)* [no. AZ usually]
narrowleaf cottonwood *(Populus angustifolia)* [infrequent & only in some areas]
gray oak *(Quercus grisea)* [occasional, HSM climate]

SHRUBS

Abundant (>25%):
*rubber rabbitbrush *(Chrysothamnus nauseosus* var. *graveolens)*
*Apacheplume *(Fallugia paradoxa)*
fourwing saltbush *(Atriplex canescens)*
California brickellbush *(Brickellia californica)*
broom snakeweed *(Gutierrezia sarothae)*
depending on geography:
big sagebrush *(Artemisia tridentata)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
desert willow *(Chilopsis linearis)*
honey mesquite *(Prosopsis glandulosa)* [HSM climate]

HERBS

Well represented (>5%), numerous species of grasses & forbs including:
blue grama *(Bouteloua gracilis)*
sideoats grama *(Bouteloua curtipendula)*
bush muhly *(Muhlenbergia porteri)*
western wheatgrass *(Pascopyrum smithii)*
yellow milkvetch *(Astragalus flavus)*

BRIEF PLANT ID NOTES

Apacheplume is easy to confuse with cliffrose *(Purshia stansburiana)*, which has sticky leaves and fewer achenes (feathery plumes) per seedhead. Apacheplume is usually in drainages and cliffrose grows on the upland sites.

SYNONOMY

broom snakeweed *(Gutierrezia sarothrae = Xanthocephalum sarothrae)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:	4 (woodlands)
Elevational Subzone:	-1 (dry, warm)
Climate class:	HSC (high sun cold) typic phase
	LSC (low sun cold) big sagebrush phase
	HSM (high sun cold) gray oak phase

PHASES

The big sagebrush (ARTR2) phase is in the LSC climate class; the gray oak (QUGR3) phase is in the HSM climate class; and the typic phase has neither gray oak or big sagebrush and is in the HSC climate class.

FIRE ECOLOGY

No specific fire ecology information for this association is available. Fire behavior in this type is probably largely dependent on density of the shrubs. Fires are probably not widespread if stream beds are present to provide fuelbreaks. Rubber rabbitbrush is usually killed by fire, but may sprout if fire intensity was not too hot (Bradley 1986b). Apacheplume resprouts vigorously after a fire (Harris 1988b).

REFORESTATION

Mechanical site prep or prescribed burning is likely to encourage rabbitbrush and Apacheplume. No disturbance is more conducive to juniper regeneration. Many species need shady microsites to regenerate. Lop and scattering of firewood slash can often create such microsites.

REVEGETATION CONSIDERATIONS

Natural revegetation following disturbances is usually rapid due to the resprouting of shrubs and grasses.

COMMENTS

Arroyo cutting and lowered water tables can reduce or eliminate the potential for cottonwoods. Apacheplume is an indicator of excessive drainage (e.g. deep, gravelly soils). Good potential for palatable deer browse if Apacheplume is present.

REFERENCE(S)

Bradley 1986b
Dick-Peddie *et al*. 1984
Edwards *et al*. 1987
Harris 1988b
Souders 1985
USFS 1987a
USFS 1986

oneseed juniper/winterfat
Juniperus monosperma/ Krascheninnikovia lanata

JUMO/KRLA2

(Formerly: Juniperus monosperma/Ceratoides lanata)

SYNONYMS

Juniperus monosperma/Ceratoides lanata (USFS 1986, 1987a)

CODE(S)

typic phase 2 01 40

KEY CRITERIA

The soils are calcareous and the plant association has ***winterfat** *(Krascheninnikovia lanata)* present. The overstory consists of ***oneseed juniper**.

LOCATION

This plant association is known from western and central New Mexico where it occurs in localized settings (i.e. not extensive). Found on valley plains from 6,000' to 6,500' (1830 -1980 m). Soils are calcareous.

TREES

Well represented (>5%):
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Well represented (>5%):
*winterfat *(Krascheninnikovia lanata)*
fourwing saltbush *(Atriplex canescens)*
tree cholla *(Opuntia imbricata)*
skunkbush sumac *(Rhus trilobata)*
soaptree yucca *(Yucca elata)*
broom snakeweed *(Gutierrezia sarothae)*

HERBS

Well-represented (>5%) or abundant (>25%):
blue grama *(Bouteloua gracilis)*
sand dropseed *(Sporobolus cryptandrus)*
spike dropseed *(Sporobolus contractus)*
Indian ricegrass *(Oryzopsis hymenoides)*
bottlebrush squirreltail *(Elymus elymoides)*
galleta *(Hilaria jamesii)*
New Mexico needlegrass *(Stipa neomexicana)*
globemallow *(Sphaeralcea* spp.)
ring muhly *(Muhlenbergia torreyi)*
rose heath *(Chaetopappa ericoides)*

BRIEF PLANT ID NOTES

Winterfat is a shrub or spreading subshrub with erect branches sporting tufts of seeds, each enclosed by 2 papery brachts covered in white silky hairs.

SYNONYMY

broom snakeweed *(Gutierrezia sarothrae = Xanthocephalum sarothrae)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSC (high sun cold)

FIRE ECOLOGY

Although no information is available on fire response in this plant association, in general winterfat is known to resprout vigorously from the surviving root crown or caudex after most fires. Early fall fire can be most damaging to winterfat. (Holifield 1987).

REVEGETATION CONSIDERATIONS

Winterfat is often seeded and planted on disturbed sites including mine spoils, drilling pad sites, etc. (Holifield 1987). Winterfat

is difficult to cultivate. Many seed sources available for winterfat are from other regions where a lower elevation variety occurs, and may not be suitable for this plant association (Suminski, 1996, personal communication). If planting winterfat, try to use local seed.

COMMENTS

Winterfat is evergreen and provides nutrious, palatable forage year-round. It is especially important in winter when forage is limited. It is used by cattle, sheep, pronghorn, bighorn sheep, elk, deer, and a number of small mammals. Winterfat is intolerant of shading and will decrease as tree density increases. (Holifield 1987).

REFERENCE(S)

Holifield 1987
USFS 1986
USFS 1987a

oneseed juniper/ sacahuista-lecheguilla

JUMO/NOMI-AGLE

(Formerly: one-seed juniper/beargrass-lechuguilla)

Juniperus monosperma/ Nolina microcarpa-Agave lechuguilla

CODE(S)

typic phase 2 01 41 0

KEY CRITERIA

An open cover of ***oneseed juniper** with a strong shrubby component, consisting primarily of ***sacahuista (beargrass)** and ***lecheguilla**, with a grassy understory.

LOCATION

Known from the Guadalupe Mountains and the southern portion of the Sacramento Mountains in southern New Mexico, this association occurs on limestone slopes, 4,300' - 4,600' (1315 -1400 m).

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSM (high sun mild)

TREES

Open cover (3 - 10%):
oneseed juniper *(Juniperus monosperma)*

SHRUBS

Well represented (>5%), dominated by evergreen rosette species:
*sacahuista *(Nolina microcarpa)*
*lecheguilla *(Agave lechuguilla)*
green sotol *(Dasylirion leiophyllum)*
yucca *(Yucca* spp.)
other species may include:
tree cholla *(Opuntia imbricata)*
skeletonleaf goldeneye *(Viguiera stenoloba)*

HERBS

Well represented (>5%), especially grasses:
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
hairy woollygrass *(Erioneuron pilosum)*
slim tridens *(Tridens muticus)*
bush muhly *(Muhlenbergia porteri)*
curlyleaf muhly *(Muhlenbergia setifolia)*
plains bristlegrass *(Setaria macrostachya)*
hairy woollygrass
(Erioneuron pilosum = Tridens pilosus)

BRIEF PLANT ID NOTES

Sacahuista is also known as beargrass. Although a basal rosette species from the lily family (like yucca, sotol, and agave), the bunch of relatively narrow leaves resembles a very large bunch grass in form. The lecheguilla is also a basal rosette species from the lily family. Lecheguilla has semisucculent, banana-shaped leaves, generally less than 16" long, with spines along the leaf margin that point to the base of the plant. The terminal spine is often longer than one inch. It grows in colonies, often forming dense mats.

SYNONOMY

hairy woollygrass *(Erioneuron pilosum = Tridens pilosus)*

ALSO SEE

Similar to JUMO/AGLE, but more grassy, and sacahuista and lecheguilla codominate the shrub layer; Gehlbach 1967.

FIRE ECOLOGY

Little is known about fire in this plant association. Sacahuista resprouts from the woody, underground caudex after a fire, but recovery to pre-burn canopy cover should be reduced (Griffith 1991, Johnsen 1962).

COMMENTS

The degree of utilization of sacahuista may indicate range condition: good = flower stalks selectively browsed and foliage exhibits no cropping; fair = no flower stalks and foliage shows signs of cropping; and poor = pure stands of sacahuista are noticeably hedged (from Darrow, quoted by Griffith 1991). This utilization can be from wildlife or livestock. In some areas, sacahuista is harvested under special permit for broom material. In this case, sacahuista utilization would be a poor indication of range conditions.

REFERENCE(S)

Gehlbach 1967
Griffith 1991
Johnsen 1962
Moir & Carleton 1987
USFS 1986

oneseed juniper/wavyleaf oak JUMO/QUPA4
Juniperus monosperma/ Quercus X pauciloba

(Formerly: Juniperus monosperma/Quercus undulata)

SYNONYMS

Juniperus monosperma/Quercus undulata (USFS 1986, USFS 1987a)

CODE(S)

typic phase 2 01 40 0

KEY CRITERIA

A chaparral woodland association where shrubs are generally abundant (>25%), and dominated by ***wavyleaf oak**. Junipers are of low stature (<16' or 5 M).

LOCATION

Found in southern and central New Mexico, and locally in northern New Mexico. Occurs on rocky slopes between 15-40% slopes, intergrading to scarp woodland with increasing steepness and rocky outcrop terrain, 6,000'-6,500' (1830-1980 m).

ALSO SEE

New Mexico Environmental Institute (1971), associations 3 & 4; Juniper-oak breaks and juniper associations: Martin, Fletcher, & Knight (1981); Naumann (1987); Pettit *et al*. (1980): JUNI-QUUN-BOCU. Otherwise a poorly described chaparral woodland association.

TREES

Well represented (>5%), and of low stature (<16' or 5 m):
oneseed juniper *(Juniperus monosperma)*
gray oak *(Quercus grisea)*
[occassional, HSM climate]

SHRUBS

Abundant (>25%):
wavyleaf oak *(Quercus* X *pauciloba)
shrub live oak *(Quercus turbinella)*
Apacheplume *(Fallugia paradoxa)*
fourwing saltbush *(Atriplex canescens)*
sacahuista *(Nolina microcarpa)*
featherplume *(Dalea formosa)*
tree cholla *(Opuntia imbricata)*
pricklypear *(Opuntia* spp.)
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus)*
yucca *(Yucca* spp.)
pale wolfberry *(Lycium pallidum)*
Mormon tea *(Ephedra viridis)*

HERBS

Common (>1%):
sideoats grama *(Bouteloua curtipendula)*
grama *(Bouteloua* spp.)
bush muhly *(Muhlenbergia porteri) pauciflora)*
curlyleaf muhly *(Muhlenbergia setifolia)*
needlegrass *(Stipa* spp.)
bottlebrush squirrel tail *(Elymus elymoides)*
plains lovegrass *(Eragrostis intermedia)*
sagewort *(Artemisia* spp.)

BRIEF PLANT ID NOTES

Wavyleaf oak is by definition a hybrid oak, usually between Gambel oak and another oak. Leaves are smaller than Gambel oak and wavy to coarsely toothed. This oak may be either deciduous or evergreen, and usually occurs as a shrub.

SYNONYMY

wavyleaf oak *(Quercus* X *pauciloba = Quercus undulata)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus = C. breviflorus)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: HSC (high sun cold)
HSM (high sun mild)

PHASES

No phases are recognized here for this plant association, however Naumann (1987) describes five plant communities in northeastern New Mexico that contain oneseed juniper and wavyleaf oak: JUMO/QUUN-RHTR, PAIN phase; JUMO/QUUN-RHTR; JUMO/QUUN-CEMO; JUMO/QUUN-NOTE; and JUMO/QUUN-PRGL2. The HSM climate JUMO/QUPA4 would include gray oak and shrub live oak, not found in the HSC climate stands.

FIRE ECOLOGY

Within the Great Plains Province, juniper-wavyleaf oak woodlands may occur on prominent escarpments and topographic breaks which serve as refugia from grass fires for formerly widespread woodlands from the late Pleistocene and early Holocene (Naumann 1987).

REVEGETATION CONSIDERATIONS

Natural revegetation is rapid due to oak sprouting.

COMMENTS

Livestock grazing in this association is generally hampered by lack of surface water, impenetrable oak thickets, and typically low forage production.

REFERENCE(S)

Martin, Fletcher, & Knight 1981
Moir & Carleton 1987
Naumann 1987
New Mexico Environmental Institute 1971
Pettit *et al*. 1980
Stuever 1995
USFS 1987a
USFS 1986

redberry juniper/crucifixion thorn
Juniperus erthryocarpa/
Canotia holacantha

JUER/CAHO3

CODE(S)

typic phase 2 30 03 0

KEY CRITERIA

A juniper woodland of ***redberry juniper** and Utah juniper amid a shrubby and grassy matrix containg ***crucifixion thorn**.

STRUCTURE

This type is subject to soil erosion and has low firewood productivity. The site index for juniper is low.

LOCATION

Found in central Arizona south of the Mogollon Rim (including Prescott and Tonto National Forests, Fort Apache and San Carlos Apache Reservations), this association occurs on dissected elevated plains, eroding breaks of valley fill alluvia, and steep, erosional hills. Soils are of calcareous parent materials, and in the thermic (mean annual soil temperature = 59 -72 degrees F) soil temperature regime. Mean annual precipitation (MAP) = 16-20"/yr. Mean annual air temperature (MAAT) = 59 -63 degrees F.

ALSO SEE

JUER/QUTU2. TES Mapping Units 3350-52, 3359-60 in northern portion of the Tonto NF.

TREES

Well represented (5-10% cover):
redberry juniper *(Juniperus erythrocarpa)*
Utah juniper *(Juniperus osteosperma)*

SHRUBS

Well represented (>5%):
*crucifixion thorn *(Canotia holacantha)*
shrub live oak *(Quercus turbinella)*
sacahuista *(Nolina microcarpa)*
red barberry *(Mahonia haematocarpa)*
Fremont mahonia *(Mahonia fremontii)*
cholla & pricklypear *(Opuntia* spp.)
common sotol *(Dasylirion wheeleri)*
velvet mesquite *(Prosopsis velutina)*
broom snakeweed *(Gutierrezia sarothae)*
Wrights buckwheat *(Eriogonum wrightii)*
banana yucca *(Yucca baccata)*
soaptree yucca *(Yucca elata)*

HERBS

Scarce (<1%) or common (>1%):
sideoats grama *(Bouteloua curtipendula)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
threeawn *(Aristida* spp.)
sand dropseed *(Sporobolus cryptandrus)*
New Mexico needlegrass *(Stipa neomexicana)*
Herter cane bluestem *(Bothriochloa barbinodis)*
little bluestem *(Schizachyrium scoparium)*
curlymesquite *(Hilaria belangeri)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
bottlebrush squirreltail *(Elymus elymoides)*
bush muhly *(Muhlenbergia porteri)*
slim tridens *(Tridens muticus)*
and scattered forbs

BRIEF PLANT ID NOTES

Generally in Arizona, oneseed juniper and redberry juniper are separated geographically with oneseed occurring above the Mogollon

Rim and redberry occurring below the Mogollon Rim. There is a slight overlap in ranges below and adjacent to the Mogollon Rim. Here are a few characteristics to try to separate these junipers: 1.) Redberry juniper produces pollen in the late fall and early winter, while oneseed juniper produces pollen in the late winter and early spring. 2.) Redberry juniper is more likely to have a single, straight trunk, rather than the multistemmed oneseed juniper. 3.) The shreddy bark of redberry juniper is tighter than the shreddy, stringy bark of oneseed juniper. 4.) The mature "berry" of redberry juniper is reddish-brown, rather than the blueish-brown "berry" of the oneseed juniper (Fletcher 1985). The scientific name of redberry juniper is now back to *Juniperus coahuilensis* according to the new *Flora of Arizona* currently in preparation. This name was published in 1993 in the Journal of the Arizona-Nevada Academy of Science, but at this printing, has not changed in the "PLANTS" database which is the official reference for this publication.

Crucifixion thorn is a distinctive shrub or small tree. Often dominated by stems, as the leaves are drought deciduous. The woody, oval fruit stays on the stem through spring and splits into 5 parts.

SYNONOMY

redberry juniper *(Juniperus erythrocarpa = J. coahuilensis)*
Fremont mahonia *(Mahonia fremontii = Berberis fremontii)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
Fendler threeawn = red threeawn *(Aristida purpurea* var. *longiseta = A. longiseta)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 4 (woodlands)
Elevational Subzone: -1 (warm, dry)
Climate class: LSM (low sun mild)

FIRE ECOLOGY

JUER/CAHO3 plant associations today may have had more of an herbaceous component prior to widespread fire exclusion associated with heavy grazing and, much later, effective fire suppression. Fires may have maintained more savanna-like conditions, where large junipers were generally not killed by fires, but regeneration was limited (Sullivan 1993).

REVEGETATION CONSIDERATIONS

Natural revegetation is very slow.

COMMENTS

See TES reports for extreme soil limitations.

REFERENCE(S)

Fletcher 1985
Stuever 1995
Sullivan 1993
USFS 1987b

redberry juniper/shrub live oak
Juniperus erthryocarpa/
Quercus turbinella

JUER/QUTU2

CODE(S)

shrub live oak (QUTU2) phase	2 30 04 0
mesquite (Prosopsis) phase	2 30 04 1
blue grama (BOGR2) phase	2 30 04 2

KEY CRITERIA

***Redberry juniper** dominates this shrubby woodland, where ***shrub live oak** is well represented and often abundant. Crucifixion thorn is absent.

STRUCTURE

This type generally provides moderate forage for cattle in early succession, although if shrub live oak is abundant, forage value rating will be low. Forage for cattle decreases as tree cover increases.

LOCATION

Found below the Mogollon Rim to SE Arizona, this association occurs on complex hillslopes, dissected pediments and toeslopes, elevated plains and alluvial fans, and eroding breaks of old valley fill alluvium. Often occurring on moderately steep and steep slopes, elevations range around 3,600' - 4,800' (1100 -1460 m). Soils are in the thermic (mean annual soil temperature = 59 -72 degrees F) soil temperature regime. Mean annual precipitation (MAP) = 16-20"/yr. Mean annual air temperature (MAAT) = 59-63 degrees F.

ALSO SEE

JUER/CAHO3 also has shrub live oak and is usually found on eroding breaks with calcareous soils. In SW NM (HSM climate), see the honey mesquite (PRGL) phase of JUMO/BOGR2 occurring, for example, on TES mapping units 3828, 3829, 3945, 3947, 3971 in the Glenwood RD (Souders 1985). On heavy clay soils (elevated and valley plains), see JUOS/HIMU.

For this association, see TES mapping units 2055, 3053, 3181, 3313, & 3809 on the Globe Ranger District 3050, 3060, 3231, 3236, 3261, 3333, 3339, 3371, 3469, 3521, 3760, & 3761 for northern portions of the Tonto NF.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:	4 (woodlands)
Elevational Subzone:	-1 (warm, dry)
Climate class:	LSM (low sun mild)

TREES

Well represented (5 - 15% canopy cover):
redberry juniper *(Juniperus erythrocarpa)*
Utah juniper *(Juniperus osteosperma)*
[not always present]
yellow paloverde *(Parkinsonia microphylla)*
[occassional, Globe RD]

SHRUBS

Well represented (>5%) or abundant (>25%):
*shrub live oak *(Quercus turbinella)*
velvet mesquite *(Prosopsis velutina)*
red barberry *(Mahonia haematocarpa)*
Fremont mahonia *(Mahonia fremontii)*
catclaw acacia *(Acacia greggii)*
fairyduster *(Calliandra eriophylla)*
desert ceanothus*(Ceanothus greggii)*
squawbush *(Condalia spathulata)*
skunkbush sumac *(Rhus trilobata)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
sacahuista *(Nolina microcarpa)*
broom snakeweed *(Gutierrezia sarothae)*
bastardsage *(Eriogonum wrightii)*
littleleaf ratany *(Krameria erecta)*
tulip pricklypear *(Opuntia phaeacantha)*

HERBS

Common (>1%) to abundant (>25%), depending on shrub cover:

blue grama *(Bouteloua gracilis)*
hairy grama *(Bouteloua hirsuta)*
black grama *(Bouteloua eriopoda)*
sideoats grama *(Bouteloua curtipendula)*
threeawn *(Aristida* spp.)
sand dropseed *(Sporobolus cryptandrus)*
curlymesquite *(Hilaria belangeri)*
[heavy clay soils]
ring muhly *(Muhlenbergia torreyi)*
Herter cane bluestem *(Bothriochloa barbinodis)*
little bluestem *(Schizachyrium scoparium)*
bush muhly *(Muhlenbergia porteri)*
prairie junegrass *(Koeleria macrantha)*
muttongrass *(Poa fendleriana)*
bottlebrush squirrel tail *(Elymus elymoides)*
needlegrass *(Stipa* spp.)
slim tridens *(Tridens muticus)*
globemallow *(Sphaeralcea* spp.)
foxtail brome *(Bromus rubens)*
lacy tansyaster *(Machaeranthera pinnatifida)*
redstem stork's bill *(Erodium cicutarium)*
and other annuals

BRIEF PLANT ID NOTES

See JUER/CAHO for separating redberry juniper and oneseed juniper. Also note that a new scientific name for redberry juniper is *Juniperus coahuilensis* according to the new *Flora of Arizona* in preparation.

Shrub live oak has thick, stiff, evergreen leaves with spine-tipped teeth. The upper leaf surface is blue-green, and yellow-green beneath. Leaves are small for oaks, approx. 1/2" to 1-1/4" long.

SYNONOMY

redberry juniper *(Juniperus erythrocarpa = J. coahuilensis)*
yellow paloverde *(Parkinsonia microphylla = Cercidium microphyllus)*
Fremont mahonia *(Mahonia fremontii = Berberis fremontii)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
littleleaf ratany *(Krameria erecta = K. parvifolia)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
lacy tansyaster *(Machaeranthera pinnatifida = Haplopappus spinulosus)*

PHASES

The shrub live oak phase has >25% cover of shrub live oak. In the mesquite (PRVE phase), mesquite is at least common (>1%). If shrub live oak is <25% cover, and mesquite is scarce, then the phase is blue grama (BOGR).

FIRE ECOLOGY

Burning usually favors oaks and shrubs. Fires may produce chaparral vegetation which can be an undesirable fire hazard in urban interface settings.

REFORESTATION

Firewood harvest by clearcut or seedtree methods will favor oak and shrub species rather than juniper. Juniper regeneration can be encouraged through selection and shelterwood harvesting. Planting is not a common practice and no information on planting success is available.

REVEGETATION CONSIDERATIONS

Revegetation can be rapid due to oak re-sprouting.

COMMENTS

Photographic records indicate that shrub live oak and mesquite have increased in geographic extent and coverage since about 1900 (USFS 1987b). This association can be subject to high erosion if overgrazed.

REFERENCE(S)

Fletcher 1985
Moir & Carleton 1987
Souders 1985
Sullivan 1993
TES Globe RD1984
USFS 1987b

Pinchot juniper/creosotebush JUPI/LATR2

(Formerly: oneseed juniper/creosotebush

Juniperus pinchotii/Larrea tridentata

(Formerly: Juniperus monosperma/Larrea divaricata)

SYNONYMS

Juniperus monosperma/*Larrea divaricata* (USFS 1987b).

CODE(S)

typic phase 2 01 43 0

KEY CRITERIA

A wide scattering of low stature (<16') ***Pinchot juniper** amid a shrubby matrix containing ***creosotebush**.

LOCATION

Known from the Guadalupe Mountains in southern New Mexico, this association occurs on plains and piedmonts, 3,500' - 4,500' (1075 -1375 m).

ALSO SEE

Similar to JUMO/AGLE, but with creosotebush. TES - South La Luz Grazing Allotment 1981, mapping units 274 & 278.

TREES

Scattered:
Pinchot juniper *(Juniperus pinchotii)*

SHRUBS

Well represented (>5%):
*creosotebush *(Larrea tridentata)*
lecheguilla *(Agave lechuguilla)*
green sotol *(Dasylirion leiophyllum)*
sacahuista *(Nolina microcarpa)*
yucca *(Yucca* spp.)
tree cholla *(Opuntia imbricata)*
skeletonleaf goldeneye *(Viguiera stenoloba)*

HERBS

Scarce (<1%) or common (>1%):
sideoats grama *(Bouteloua curtipendula)*
black grama *(Bouteloua eriopoda)*
hairy woollygrass *(Erioneuron pilosum)*
slim tridens *(Tridens muticus)*
bush muhly *(Muhlenbergia porteri)*
curlyleaf muhly *(Muhlenbergia setifolia)*
plains bristlegrass *(Setaria macrostachya)*

BRIEF PLANT ID NOTES

Pinchot juniper is similar to redberry juniper *(J. erythrocarpa)* vegetatively, but grows in southeastern New Mexico and Texas. Unlike oneseed juniper *(J. monosperma),* the red berry of the Pinchot juniper does not have a waxy bloom (Fletcher 1985).

The small, bright green leaves of the creosotebush are thick, resinous and strongly scented. The many branches are brittle, and leaves are clumped at the ends of the branches.

SYNONYMY

creosotebush *(Larrea tridentata = L. divaricata)*
hairy woollygrass *(Erioneuron pilosum = Tridens pilosus)*

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 3 (grasslands)
Elevational Subzone: 0 (typic)
Climate class: HSM (high sun mild)

FIRE ECOLOGY

For many areas, fire exclusion has contributed to creosotebush range expansion (Marshall & Korthius 1995). Creosotebush is poorly

adapted to fire, and only survives fires that burn in patches or are of low severity. Season of burning, fuel quantity, fire temperature, and age of existing plants affect the ability of creosotebush to sprout. Marshall and Korthius (1995) suggests conducting prescribed burns for creosotebush control in spring or early fall, after 2 years of above average plant growth.

REVEGETATION CONSIDERATIONS

Revegetating creosotebush-inhabitated sites with other plant species is very difficult (Marshall and Korthius 1995). Creosotebush is susceptible to severe drought during short-term climate changes such as those associated with the El Niño-Southern Oscillation phenonema. The success of creosotebush control projects may be enhanced by timing activities with expected drought conditions (i.e. predicted La Nina conditions).

COMMENTS

Possibly derived from JUMO/NOMI-AGLE plant association or desert grassland as a result of livestock grazing, soil erosion, or climatic change. Creosotebush has probably expanded into many areas of this plant association within the last 100 years, and once established, is difficult to control. (Gardiner 1951)

REFERENCE(S)

Fletcher 1985
Gardiner 1951
Marshall & Korthuis 1995
Moir & Carleton 1987
New Mexico Environmental Institute 1971
USFS 1986
VanDevender *et al*. 1984

Scarp woodland

CODE(S)
typic phase 2 50 00 0

KEY CRITERIA
Woodland sites with slopes exceeding 40% with cobbly, bouldery soils having much discontinuity because of rock outcrop or bare rock exposure.

STRUCTURE
Tree roots often grow in cracks and fissures. Trees may be stunted where moisture is limited. Stocking is often light. Wood production is typically very low. Steep, rough topography limits commodity-oriented use and vegetation management opportunities.

LOCATION
Widespread in the Southwest and Great Plains. Often occurs on upper slopes as mesa caprock, although other landforms may also qualify as "scarp".

ADJACENT PLANT ASSOCIATIONS
May adjoin a variety of woodland types.

ALSO SEE
QUGR/CEMO, PIED/CEMO, JUMO/QUTU, JUMO/QUPA4, JUDE/QUGR; Wells (1970); TES mapping units with very steep slopes and rock outcrop components, such as Mapping Unit 278 (Edwards *et al*. 1987), Mapping Units 105, 113, 117, 127, 133, 208 (Gass *et al*. 1983), and Mapping Unit 74 (Gass *et al*. 1981); Naumann (1987) divides scarp woodlands into local plant associations.

TREES
Well represented (>5%), often rooted in fissures. Woodland species composition varies with geography and elevation.

SHRUBS
Well represented (>5%), usually numerous species are found. Composition varies with geography and topography.

HERBS
Well represented (>5%). Numerous species of both grasses and forbs.

CRYPTOGAMS
Lichen growth on rocks can be dense.

TERRESTRIAL ECOSYSTEM CLIMATE CLASS
Life Zone Class: 4 (Woodlands)
Elevational Subzone: -1 (warm, dry), 0 (typic), +1 (cool, wet)
Climate class: varies

FIRE ECOLOGY
Most sites may be protected from frequent fire regimes and may contain important dendrochronology woody material.

REFORESTATION
Natural regeneration is spotty and hard to predict. Artificial regeneration is usually impractical due to the absence of plantable sites.

REVEGETATION CONSIDERATIONS
Revegetation may be slow and spotty.

COMMENTS
Scarp woodlands can provide important wildlife habitat, visual quality, and dispersed recreational opportunities.

REFERENCE(S)
Edwards *et al*. 1987
Naumann 1987
USFS 1987a
USFS 1986
Wells 1970

Synonymy

Listed here are most of the major changes in plant names mentioned in the plant association descriptions. Except as mentioned in the Introduction, the following are the "accepted" synonyms as appeared in the 5/21/95 version of USDA, NRCS 1995, The PLANTS database. Listed for each taxon treated are the accepted common name and its accepted scientific name. The former common name(s) and/or the former scientific names follow depending on the nature of the change involved. Occasionally, more than one change is shown.

This list is separated into three main categories—trees, shrubs, and herbs—each category is organized alphabetically by scientific name.

TREES

corkbark fir *(Abies bifolia = A. lasiocarpa* var. *arizonica)*
thinleaf alder *(Alnus incana* ssp. *tenuifolia = A. tenuifolia)*
redberry juniper *(Juniperus erythrocarpa = J. coahuilensis)*
yellow paloverde *(Parkinsonia microphylla = Cercidium microphyllus)*
Arizona pine *(Pinus arizonica = P. ponderosa* var. *arizonica)*
Arizona pinyon *(Pinus fallax = Pinus californiarum)*
Rio Grande cottonwood *(Populus deltoides* ssp. *wislizeni = P. fremontii)*

SHRUBS

Utah serviceberry *(Amelanchier utahensis* ssp. *utahensis = A. alnifolia)*
black sagebrush *(Artemisia nova) =* low sagebrush *(A. arbuscula* var. *nova)*
dwarf stickpea *(Calliandra humilis* var. *reticulata = C. reticulata)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus = C. breviflorus)*
Mexican orange *(Choisya dumosa* var.*arizonica) =* star-leaf *(C. arizonica)*
redosier dogwood *(Cornus sericea* ssp. *sericea = C. stolonifera)*
beechleaf frangula *(Frangula betulifolia = Rhamnus betulaefolia)*
velvet ash *(Fraxinus velutina = F. v.* ssp. *pennsylvanica)*
spiny greasebush *(Glossopetalon spinescens = G. nevadense)*
broom snakeweed *(Gutierrezia sarothrae = Xanthocephalum sarothrae)*
cliffbush = waxflower = *(Jamesia americana)*
littleleaf ratany *(Krameria erecta = K. parvifolia)*
winterfat *(Krascheninnikovia lanata = Ceratoides lanata = Eurotia lanata)*
creosotebush *(Larrea tridentata = L. divaricata)*
Fremont mahonia *(Mahonia fremontii = Berberis fremontii)*
red barberry *(Mahonia haematocarpa = Berberis haematocarpa)*
algerita *(Mahonia trifoliata = Berberis trifoliata)*
Oregongrape *(Mahonia repens = Berberis repens)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera = M. biuncifera)*
Rio Grande saddlebush *(Mortonia sempervirens* ssp. *scabrella = M. scabrella)*
boxleaf myrtle *(Paxistima myrsinites)* = mountain lover *(Pachystima myrsinites)*

broom dalea *(Psorothamnus scoparius = Dalea scoparia)*
Stansbury cliffrose *(Purshia stansburiana = Cowania stansburiana = C. mexicana)*
wavyleaf oak *(Quercus* X *pauciloba = Q. undulata)*
pubescent squawbush *(Rhus trilobata* var. *pilosissima = R. aromatica)*
evergreen sumac = leatherleaf sumac *(Rhus virens* var. *choriophylla = R. coriophylla)*
Wood rose *(Rosa woodsii* var. *ultramonana = R. w.* var. *woodsii)* = Fendler rose *(R. fendleriana)*
Wood rose (*Rosa woodsii* var. *ultramontana = R. arizonica)*
black elderberry *(Sambucus racemosa* ssp. *pubens* var. *melanocarpa = S. melanocarpa)*

HERBS

western yarrow *(Achillea millefolium* var. *occidentalis = A. lanulosa)*
Fendler threeawn *(Aristida purpurea* var. *fendleriana = A. fendleriana)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)* = red threeawn *(A. longiseta)*
nodding brome *(Bromus anomalus = B. porteri)*
Canadian brome *(Bromus canadensis = B. richarsonii)*
rose heath *(Chaetopappa ericoides = Leucelene ericoides)*
rock clematis *(Clematis columbiana var. columbiana = C. pseudoalpina)*
redosier dogwood *(Cornus sericea* ssp. *sericea = C. stolonifera)*
owlsclaws *(Dugaldia hoopsii)* = orange sneezeweed *(Helenium hoopsii)*
Arizona wheatgrass *(Elymus arizonicus = Andropogon arizonicum)*
bottlebrush squirreltail *(Elymus elymoides = Sitanion hystrix)*
sprucefir fleabane *(Erigeron eximius)* = forest fleabane *(E. superbus)*
trailing fleabane *(Erigeron flagellaris = E. nudiflorus)*
New Mexico fleabane *(Erigeron neomexicanus = E. delphinifolius)*
Vreeland erigeron *(Erigeron vreelandii = E. platyphyllus*)
hairy woollygrass *(Erioneuron pilosum = Tridens pilosus)*
woodland strawberry *(Fragaria vesca* var. *americana = F. americana)*
Virginia strawberry *(Fragaria virginiana* ssp. *virginiana = F. ovalis = F. canadensis)*
showy frasera *(Frasera speciosa)* = green gentian *(Swertia radiata)*
Mexican bedstraw *(Galium mexicanum* ssp. *asperrimum = G. asperrimum)*
hairy goldenaster*(Heterotheca villosa* var.*villosa = Chrysopsis villosa)*
Idaho hymenopappus *(Hymenopappus filifolius* var. *lugens = H. lugens)*
prairie junegrass *(Koelaria macrantha = K. pyrimidata = K. cryptandrus)*
Arizona peavine *(Lathyrus lanszwertii* var. *arizonicus = L. arizonicus)*
beardless wildrye *(Leymus triticoides* = Elymus triticoides) slender goldenweed *(Macraeranthera gracilis = Haplopappus gracilis)*
lacy tansyaster *(Macraeranthera pinnatifida = Haplopappus spinulosus)*
feathery false Solomon seal *(Maianthemum racemosum = Smilacina racemosa)*

starry false Solomon seal *(Maianthemum stellatum = Smilacina stellata)*
mintleaf beebalm *(Monarda fistulosa* ssp. *fistulosa* var. *menthifolia = M. menthifolia)*
slimflower muhly *(Muhlenbergia tenuifolia = M. monticola)*
sidebells wintergreen *(Orthilia secunda = Ramischia secunda)*
bluntseed sweetroot = sweetcicily *(Osmorhiza depauperata = O. obtusa)*
western wheatgrass *(Pascopyrum smithii = Agropyron smithii)*
Pringle spear grass *(Piptochaetium pringlei = Stipa pringlei)*
canyon bog orchid *(Platanthera sparsiflora* var. *sparsiflora = Habenaria sparsiflora)*
skunkweed polemonium *(Polemonium pulcherrimum* ssp. *delicatum)* = Jacob's ladder *P. delicatum)*
slimflower scurfpea *(Psoralidium tenuiflorum = Psoralea tenuiflora)*
black elderberry *(Sambucus racemosa* ssp. *pubens* var. *melanocarpa = S. melanocarpa)*
Texas bluestem *(Schizachyrium cirratum = Andropogon cirratus)*
little bluestem *(Schizachyrium scoparium = Andropogon scoparius)*
bittercress ragwort = cardamine groundsel *(Senecio cardamine)*
Parry goldenrod *(Solidago parryi = Haplopappus parryi = Oreochrysum parryi)*
threenerve goldenrod *(Solidago velutina = S. sparsifolia)*
Dore spear grass *(Stipa nelsonii* spp. *dorei)* = western needlegrass *(S. columbiana)*
mountain thermopsis *(Thermopsis rhombifolia* var. *montana = T. montana = T. pinetorum)*
pine goldenpea *(Thermopsis rhombifolia* var. *divericarpa = T. divericarpa)*
rough tridens *(Tridens muticus* var. *elongatus = T. elongatus)*
sharpleaf valerian *(Valeriana acutiloba* var. *acutiloba = V. capitata* var. acutiloba *= V. capitata)*

Plant Reference List

This reference list compiles the plant names which appear in the plant association descriptions. It is not necessary to be familiar with all of these plants in order to accurately be able to identify plant associations in the Southwest. For most geographic areas, you will need to be familar with about 75 to 100 different species to be able to accurately identify plant associations. Plants with a * are key indicator plants or frequently appear in association descriptions. This list is separated in three main categories—trees, shrubs, and herbs—and is then organized alphabetically.

TREES

*corkbark fir *(Abies bifolia)*	
*white fir *(Abies concolor)*	
*Arizona alder *(Alnus oblongifolia)*	
*thinleaf alder *(Alnus incana* ssp. *tenuifolia)*	
Arizona madrone *(Arbutus arizonica)*	
velvet ash *(Fraxinus velutina)*	
*Arizona walnut *(Juglans major)*	
*alligator juniper *(Juniperus deppeana)*	
*redberry juniper *(Juniperus erythrocarpa)*	
*Utah juniper *(Juniperus osteosperma)*	
*oneseed juniper *(Juniperus monosperma)*	
*Pinchot juniper *(Juniperus pinchotii)*	
*Rocky Mountain juniper *(Juniperus scopulorum)*	c
yellow paloverde *(Parkinsonia microphylla)*	
*Engelmann spruce *(Picea engelmannii)*	
*blue spruce *(Picea pungens)*	
Arizona pine *(Pinus arizonica)*	C
*bristlecone pine *(Pinus aristata)*	C
*border pinyon *(Pinus discolor)*	c
*twoneedle pinyon *(Pinus edulis)*	c
*Apache pine *(Pinus engelmannii)*	C
*Arizona pinyon *(Pinus fallax)*	
*limber pine *(Pinus flexilis)*	C
*Chihuahuan pine *(Pinus leiophylla)*	c
*ponderosa pine *(Pinus ponderosa)*	C
*southwestern white pine *(Pinus strobiformis)*	C
*Arizona sycamore *(Platanus wrightii)*	a
narrowleaf cottonwood *(Populus angustifolia)*	s
Rio Grande cottonwood *(Populus deltoides* ssp. *wislizensi)*	s
*quaking aspen *(Populus tremuloides)*	s
black cherry *(Prunus serotina)*	a
*Douglas-fir *(Pseudotsuga menzensii)*	c
*netleaf oak *(Quercus rugosa)*	S

*silverleaf oak *(Quercus hypoleucoides)* S
*Emory oak *(Quercus emoryi)* s
*Gambel oak *(Quercus gambelii)* s
*gray oak *(Quercus grisea)* s
*Arizona white oak *(Quercus arizonica)* s

SHRUBS

catclaw acacia *(Acacia greggii)*
*Rocky Mountain maple *(Acer glabrum)*
*bigtooth maple *(Acer grandidentatum)*
*lecheguilla *(Agave lechuguilla)*
Palmer century plant *(Agave palmeri)*
Parry agave *(Agave parryi)*
Utah agave *(Agave utahensis)*
Utah service berry *(Amelanchier utahensis)*
service berry *(Amelanchier* spp.)
manzanita *(Arctostaphylos* spp.)
*pointleaf manzanita *(Arctostaphylos pungens)*
Pringle manzanita *(Arctostaphylos pringlei)*
*kinnikinnick *(Arctostaphylos uva-ursi)*
*Bigelow sagebrush *(Artemisia bigelovii)*
sand sagebrush *(Artemisia filifolia)*
*black sagebrush *(Artemisia nova)*
*big sagebrush *(Artemisia tridentata)*
fourwing saltbush *(Atriplex canescens)*
California brickellbush *(Brickellia californica)*
fairyduster *(Calliandra eriophylla)*
*crucifixion thorn *(Canotia holacantha)*
Bigelow bristlehead *(Carphochaete bigelovii)*
*Fendler ceanothus *(Ceanothus fendleri)*
*desert ceanothus *(Ceanothus greggii)*
hairy mountain mahogany *(Cercocarpus montanus* var. *paucidentatus)*
*true mountain mahogany *(Cercocarpus montanus)*
mountain mahogany *(Cercocarpus* spp.)
fernbush *(Chamaebatiaria millefolium)*
desert willow *(Chilopsis linearis)*
*Mexican orange *(Choisya dumosa* var. *arizonica)*
longflower rabbitbrush *(Chrysothamnus depressus)*
*rubber rabbitbrush *(Chrysothamnus nauseosus)*
green rabbitbrush *(Chrysothamnus viscidiflorus)*
rabbitbrush *(Chrysothamnus* spp.)
*blackbrush *(Coleogyne ramosissima)*
squawbush *(Condalia spathulata)*
featherplume *(Dalea formosa)*
green sotol *(Dasylirion leiophyllum)*

common sotol *(Dasylirion wheeleri)*
Mormon tea *(Ephedra viridis)*
Wrights buckwheat *(Eriogonum wrightii)*
*Apacheplume *(Fallugia paradoxa)*
cliff fendlerbush *(Fendlera rupicola)*
Utah fendlerbush *(Fendlera utahensis)*
beechleaf frangula *(Frangula betulifolia)*
eggleaf silktassel *(Garrya ovata)*
ashy silktassel *(Garrya flavescens)*
*Wright silktassel *(Garrya wrightii)*
spiny greasebush *(Glossopetalon spinescens)*
broom snakeweed *(Gutierrezia sarothae)*
gumhead *(Gymnosperma glutinosum)*
*rockspirea *(Holodiscus dumosus)*
pinque hymenoxys *(Hymenoxys richardsonii)*
*cliffbush *(Jamesia americana)*
*common juniper *(Juniperus comminus)*
littleleaf ratany *(Krameria erecta)*
*winterfat *(Krascheninnikovia lanata)*
*creosotebush *(Larrea tridentata)*
*twinflower *(Linnaea borealis)*
Arizona honeysuckle *(Lonicera arizonica)*
pale wolfberry *(Lycium pallidum)*
Fremont mahonia *(Mahonia fremontii)*
red barberry *(Mahonia haematocarpa)*
*Oregongrape *(Mahonia repens)*
algerita *(Mahonia trifoliata)*
rough mendora *(Mendora scabra)*
mimosa *(Mimosa aculeaticarpa* var. *biuncifera)*
Rio Grande saddlebush *(Mortonia scabrella)*
*sacahuista *(Nolina microcarpa)*
tree cholla *(Opuntia imbricata)*
tulip pricklypear *(Opuntia phaeacantha)*
plains pricklypear *(Opuntia polyacantha)*
walkingstick cactus *(Opuntia spinosior)*
cholla & pricklypear *(Opuntia* spp.)
Whipple cholla *(Opuntia whipplei)*
boxleaf myrtle *(Paxistima myrsinites)*
*mountain ninebark *(Physocarpus monogynus)*
honey mesquite *(Prosopsis glandulosa)*
velvet mesquite *(Prosopsis velutina)*
common chokecherry *(Prunus virginiana)*
broom dalea *(Psorothamnus scoparius)*
common hoptree *(Ptelea trifoliata)*
*Stansbury cliffrose *(Purshia stansburyiana)*

*antelope bitterbrush *(Purshia tridentata)*
shrubby forms oaks *(Quercus* spp.)
canyon live oak *(Quercus chrysolepis)*
*Gambel oak *(Quercus gambelii)*
*gray oak *(Quercus grisea)*
*silverleaf oak *(Quercus hypoleucoides)*
*netleaf oak *(Quercus rugosa)*
*wavyleaf oak *(Quercus* X*pauciloba)*
*Toumey oak *(Quercus toumeyi)*
*shrub live oak *(Quercus turbinella)*
redberry buckthorn *(Rhamnus crocaea)*
*evergreen sumac *(Rhus virens* var. *choriophylla)*
sugar sumac *(Rhus ovata)*
*skunkbush sumac *(Rhus trilobata)*
pubescent squawbush *(Rhus trilobata* var. *pilosissima)*
wax currant *(Ribes cereum)*
*gooseberry currant *(Ribes montigenum)*
orange gooseberry *(Ribes pinetorum)*
currant *(Ribes* spp.*)*
*New Mexico locust *(Robinia neomexicana)*
wild rose *(Rosa* spp.)
New Mexico raspberry *(Rubus neomexicanus)*
*western thimbleberry *(Rubus parviflorus)*
*Scouler willow *(Salix scouleriana)*
*whortleleaf snowberry *(Symphoricarpos oreophilus)*
turpentinebroom *(Thamnosma montana)*
*whortleberry *(Vaccinium myrtillus)*
skeletonleaf goldeneye *(Viguiera stenoloba)*
*canyon grape *(Vitis arizonica)*
narrowleaf yucca *(Yucca angustissima)*
*banana yucca *(Yucca baccata)*
soaptree yucca *(Yucca elata)*
Schott yucca *(Yucca schottii)*
yucca *(Yucca* spp.)

HERBS

common yarrow *(Achillea millefolium)*
Kunth onion *(Allium kunthii)*
big bluestem *(Andropogon gerardii)*
*sand bluestem *(Andropogon hallii)*
pussytoes *(Antennaria* spp.)
smallleaf pussytoes *(Antennaria parvifolia)*
rosy pussytoes *(Antennaria rosea)*
threeawn *(Aristida* spp.)

Arizona threeawn *(Aristida arizonica)*
Fendler threeawn *(Aristida purpurea* var. *longiseta)*
single threeawn *(Aristida orcuttiana)*
Fendler threeawn *(Aristida purpurea* var. *fendleriana)*
fringed sagewort *(Artemisia frigida)*
Louisiana sagewort *(Artemisia ludoviciana)*
sagewort *(Artemisia* spp.)
yellow milkvetch *(Astragalus flavus)*
pine dropseed *(Blepharoneuron tricholepis)*
Herter cane bluestem *(Bothriochloa barbinodis)*
*sideoats grama *(Bouteloua curtipendula)*
*black grama *(Bouteloua eriopoda)*
*blue grama *(Bouteloua gracilis)*
*hairy grama *(Bouteloua hirsuta)*
purple grama *(Bouteloua radicosa)*
slender grama *(Bouteloua repens)*
tasselflower brickellbush *(Brickellia grandiflora)*
Lemmon brickellbush *(Brickellia lemmonii)*
brickellbush *(Brickellia* spp.)
nodding brome *(Bromus anomalus)*
*fringed brome *(Bromus ciliatus)*
woolly brome *(Bromus lanatipes)*
foxtail brome *(Bromus rubens)*
brome *(Bromus* spp.)
drawf stickpea *(Calliandra humilis)*
drawf stickpea *(Calliandra humilis* var. *reticulata)*
White Mountain sedge *(Carex geophila)*
*dryspike sedge *(Carex foenea)*
Ross sedge *(Carex rossii)*
sedges *(Carex* spp.)
rose heath *(Chaetopappa ericoides)*
Fendler lipfern *(Cheilanthes fendleri)*
rock clematis *(Clematis columbiana)*
brittle bladderfern *(Cystopteris fragilis)*
Rose ticktrefoil *(Desmodium rosei)*
ticktrefoil (*Desmodium* spp.)
Arizona wheatgrass *(Elymus arizonicus)*
bottlebrush squirreltail *(Elymus elymoides)*
plains lovegrass *(Eragrostis intermedia)*
spreading fleabane *(Erigeron divergens)*
*sprucefir fleabane *(Erigeron eximius)*
beautiful fleabane *(Erigeron formosissimus)*
trailing fleabane *(Erigeron flagellaris)*
New Mexico fleabane *(Erigeron neomexicanus)*
Vreeland erigeron *(Erigeron vreelandii)*

winged buckwheat *(Eriogonom alatum)*
James buckwheat *(Eriogonum jamesii)*
redroot buckwheat *(Eriogonum racemosum)*
hairy woollygrass *(Erioneuron pilosum)*
redstem stork's bill *(Erodium cicutarium)*
spreading wallflower *(Erysium repandum)*
*Arizona fescue *(Festuca arizonica)*
*Thurber fescue *(Festuca thurberi)*
woodland strawberry *(Fragaria vesca)*
Virginia strawberry *(Fragaria virginiana)*
bedstraw *(Galium* ssp.)
Mexican bedstraw *(Galium mexicanum* ssp. *asperrimum)*
bracted bedstraw *(Galium microphyllum)*
pineywoods geranium *(Geranium caespitosum)*
Richardson geranium *(Geranium richardsonii)*
falsepennyroyal *(Hedeoma hyssopifolia)*
common sunflower *(Helianthus annuus)*
hairy goldenaster *(Heterotheca villosa* var. *villosa)*
yellow hawkweed *(Hieracium fendleri)*
*curlymesquite *(Hilaria belangeri)*
*galleta *(Hilaria jamesii)*
*tobosagrass *(Hilaria mutica)*
Idaho hymenopappus *(Hymenopappus filifolius* var. *lugens)*
prairie junegrass *(Koeleria macrantha)*
*Arizona peavine *(Lathyrus lanszwertii* var. *arizonica)*
green sprangletop *(Leptochloa dubia)*
mucronate sprangletop *(Leptochloa mucronata)*
*beardless wildrye *(Leymus triticoides)*
Wright deervetch *(Lotus wrightii)*
manyflowered gromwell *(Lithospermum multiflorum)*
common wolfstail *(Lycurus pheloides)*
slender goldenweed *(Machaeranthera gracilis)*
starry false Solomon's seal *(Maianthemum stellatum)*
plains blackfoot *(Melampodium leucanthum)*
Macdougal bluebells *(Mertensia macdougalii)*
Colorado four o'clock *(Mirabelis multiflora)*
*pine muhly *(Muhlenbergia dubia)*
*bullgrass *(Muhlenbergia emersleyi)*
*longtongue muhly *(Muhlenbergia longiligula)*
*mountain muhly *(Muhlenbergia montana)*
*New Mexico muhly *(Muhlenbergia pauciflora)*
bush muhly *(Muhlenbergia porteri)*
*sandhill muhly *(Muhlenbergia pungens)*
curlyleaf muhly *(Muhlenbergia setifolia)*
slimflower muhly *(Muhlenbergia tenuifolia)*

ring muhly *(Muhlenbergia torreyi)*
*screwleaf muhly *(Muhlenbergia virescens)*
*Indian ricegrass *(Oryzopsis hymenoides)*
littleseed ricegrass *(Oryzopsis micrantha)*
bulb panicgrass *(Panicum bulbosum)*
witchgrass *(Panicum capillare)*
obtuse panicgrass *(Panicum obtusum)*
western wheatgrass *(Pascopyrum smithii)*
dwarf lousewort *(Pedicularis centranthera)*
toadflax penstemon *(Penstemon linarioides)*
wild beans *(Phaseolus* spp.)
phlox *(Phlox* spp.)
*pinyon ricegrass *(Piptochaetium fimbriatum)*
Pringle needlegrass *(Piptochaetium pringlei)*
*muttongrass *(Poa fendleriana)*
*Kentucky bluegrass *(Poa pratensis)*
*Skunkbush polemonium *(Polemonium pulcherrimum* ssp. *delicatum)*
woolly cinquefoil *(Potentilla hippiana)*
white milkwort *(Polygala alba)*
greenstem paperflower *(Psilotrophe sparsiflora)*
slimflower scurfpea *(Psoralidium tenuiflorum)*
western brackenfern *(Pteridium aquilinum)*
Texas bluestem *(Schizachyrium cirratum)*
*little bluestem *(Schizachyrium scoparium)*
*bittercress ragwort *(Senecio cardamine)*
New Mexico groundsel *(Senecio neomexicanus)*
*burnet ragwort *(Senecio sanguisorboides)*
Wooton ragwort *(Senecio wootonii)*
plains bristlegrass *(Setaria macrostachya)*
Parry goldenrod *(Solidago parryi)*
coast goldenrod *(Solidago spathulata)*
threenerve goldenrod *(Solidago velutina)*
goldenrod *(Solidago* spp.)
globemallow *(Sphaeralcea* spp.)
*alkali sacaton *(Sporobolus airoides)*
spike dropseed *(Sporobolus contractus)*
sand dropseed *(Sporobolus cryptandrus)*
needlegrass *(Stipa* spp.)
*needleandthread *(Stipa comata)*
*Dore needlegrass *(Stipa nelsonii* spp. *dorei)*
New Mexico needlegrass *(Stipa neomexicana)*
desert needlegrass *(Stipa speciosa)*
Schribner needlegrass *(Stipa schribneri)*
Fendler meadowrue *(Thalictrum fendleri)*
alpine pennycress *(Thlaspi montanum* var. *montanum)*

mountain thermopsis *(Thermopsis rhombifolia* var. *montana)*
slim tridens *(Tridens muticus)*
rough tridens *(Tridens muticus* var. *elongatus)*
Rocky Mountain trisetum *(Trisetum montanum)*
sharpleaf valerian *(Valeriana acutiloba)*
American vetch *(Vicia americana)*
sweetclover vetch *(Vicia pulchella)*
Rocky Mountain zinnia *(Zinnia grandiflora)*

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