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A Vegetation Classification and Map

Guadalupe Mountains National Park

Natural Resource Report NPS/CHDN/NRR—2024/2636



ON THE COVER
The western escarpment is iconic for it steep cliffs as shown here on the shoulders of Shumard Peak.
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Guadalupe Mountains National Park

Natural Resource Report NPS/CHDN/NRR—2024/2636

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Acronyms and Abbreviations

AA:	Accuracy Assessment
CHDN:	Chihuahuan Desert Network
DOQQs:	Digital Orthophoto Quarter Quads
DRG:	Digital Raster Graphics
ESRI:	Environmental Systems Research Institute
FGDC:	Federal Geographic Data Committee
GAP:	Gap Analysis Program
GMP:	General Management Plan/Environmental Impact Statement
GIS:	Geographic Information System
GPS:	Global Positioning System
I&M:	Inventory and Monitoring
ITIS:	Integrated Taxonomic Information System
MMU:	Minimum Mapping Unit
NAIP:	National Agriculture Imagery Program
NDVI:	Normalized Difference Vegetation Index
NHNM:	Natural Heritage New Mexico
NIR:	Near-infrared
NPS:	National Park Service
NRCA:	Natural Resources Condition Assessment
NRCS:	Natural Resource Conservation Service
OP:	Observation Points
PA:	Plant Association
TM:	Landsat Thematic Mapper+
USDA:	United States Department of Agriculture
USGS:	United States Geological Survey
USNVC:	United States National Vegetation Classification
USNVCS:	United States National Vegetation Classification Standard
UNM:	University of New Mexico

Executive Summary

A vegetation classification and map for Guadalupe Mountains National Park (NP) is presented as part of the National Park Service Inventory & Monitoring - Vegetation Inventory Program to classify, describe, and map vegetation communities in more than 280 national park units across the United States. Guadalupe Mountains NP lies in far west Texas and contains the highest point in the state, Guadalupe Peak (8,751 ft; 2,667 m). The mountain escarpments descend some 5,000 ft (1,500 m) to the desert basins below forming a complex geologic landscape that supports vegetation communities ranging from montane coniferous forests down to desert grasslands and scrub. Following the US National Vegetation Classification (USNVC) standard, we identified 129 plant associations hierarchically tiered under 29 groups and 17 macrogroups, making it one of the most ecologically diverse National Park Service units in the southwestern United States. An aspect that adds to this diversity is that the park supports communities that extend southward from the Rocky Mountains (five macrogroups) and Great Plains (one macrogroup) and northward from the Chihuahuan Desert (two macrogroups) and Sierra Madre Orientale of Mexico (three macrogroups). The remaining six macrogroups are found in the Great Basin (one macrogroup), and throughout the southwestern United States (remaining five macrogroups). Embedded in this matrix are gypsum dunelands and riparian zones and wetlands that add further complexity. We describe in detail this vegetation classification, which is based on 540 vegetation plots collected between 2006 and 2010. Full descriptions and diagnostic keys to the plant associations along with an overall plant species list are provided as appendices.

Based on the vegetation classification and associated plot data, the vegetation map was developed using a combined strategy of automated digital object-oriented image classification and direct-analog image interpretation of four-band National Agricultural Imagery Program (NAIP) aerial photography from 2004 and 2008 and Landsat Thematic Mapper satellite imagery. The map is designed to facilitate ecologically-based natural resource management at a 1:24,000 scale with 0.5-ha minimum map unit size. The map legend is hierarchically structured: the upper Level 1 consists of 16 map units corresponding in most cases to the USNVC group level, and an additional map unit describing built-up land and agriculture; Level 2 is composed of 48 nested map units reflecting various combinations of plant associations. A field-based accuracy assessment using 341 vegetation plots revealed a Level 1 overall accuracy of 79% with 90% CI of 74–84% and 68% with 90% CI of 59–76% at Level 2. An annotated legend with summary descriptions of the units, distribution maps, aerial photo examples of map unit polygons, and representative photos are provided in Appendix D. Large wall-size poster maps at 1:35,000 scale were also produced following NPS cartographic standards. The report, plot data, and spatial layers are available at National Park Service Vegetation Mapping Program (https://www.nps.gov/im/vegetation-inventory.htm).

Outcomes from this project provide the most detailed vegetation classification and highest resolution mapping for Guadalupe Mountains NP to date to support many uses including fire, recreation, vegetation, and wildlife management, among others. The upper Level 1 map is particularly suited to landscape-scale, park-wide planning and linkages to its sister park, Carlsbad Caverns NP. The Level 2 mapping provides added detail for use at a more localized project scale. The overall accuracy of the maps was good, but because Guadalupe Mountains NP is primarily wilderness park, there were logistical challenges to map development and testing in remote areas that should be considered in planning management actions. In this context, some map units would benefit from further development and accuracy assessment. In particular, a higher resolution mapping of McKittrick Creek riparian habitat at 1:6,000 scale or finer is recommended for this important habitat in the park. In addition, developing a structural canopy height model from LiDAR imagery would be useful to more accurately quantify woody canopy density and height to support fire management and other habitat management issues. With respect to understanding vegetation dynamics in this time of rapid environmental change, the 540 vegetation plots themselves are sufficiently georeferenced and have the data resolution to be useful in detecting change at the decadal scales across much of the park. To this end, an additional recommendation would be to install more plots to fill the gaps among the main vegetation units of the park, both spatially and thematically. Overall, the Vegetation and Classification Map for Guadalupe Mountains NP will support the park's management efforts and enhance regional understanding of vegetation and ecology of ecosystems of the southwestern United States.

Acknowledgments

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Chapter 1: Introduction

Background, Scope, and Products

Guadalupe Mountains National Park (NP) lies in far west Texas and captures the highest point in the state, Guadalupe Peak (8,751 ft; 2,667 m), which, along with the sheer cliffs of El Capitan, form one of the most dramatic and diverse landscapes in the Chihuahuan Desert region (Figure 1). These mountain peaks anchor the west end of the ancient (Permian) Capitan Reef, a fossilized sponge-algal reef formation that extends 40 miles (64 km) to the northeast into New Mexico. The mountain escarpments descend some 3,000 ft (914 m) to the desert basins below and are bounded by broad alluvial fan piedmonts, isolated foothill ranges, gypsum dune lands, and valley bottom flats. The interior of the Guadalupe Mountains is a wilderness of steep, rugged canyons that converge in lower McKittrick Canyon, which contains one of the few perennial streams in the Trans-Pecos region of Texas. This complex geologic template has given rise to diverse vegetation communities that now provide habitat and forage for a plethora of wildlife as well as exceptional recreational opportunities for park visitors. In addition, the park preserves a rich cultural history of the region's settlement by prehistoric and recent Native Americans, Spanish explorers, Anglo-Americans, and others who have left their imprint on the landscape and the associated ecology.

The National Park Service (NPS) manages park biological resources in concert with geological and cultural resources. A key to effective management of park resources is the development of a high-resolution vegetation map that can support activities such as flora and fauna habitat modeling, recreation planning, fire management, ecological and cultural research, and broad-scale facilities planning.

To meet this objective, Natural Heritage New Mexico (NHNM; a division of the Museum of Southwestern Biology at the University of New Mexico), in collaboration with the NPS Chihuahuan Desert Network (CHDN); NatureServe (the national network organization of Natural Heritage Programs and Conservation Data Centers); and the staff at Guadalupe Mountains NP, developed a vegetation classification and vegetation map for the park following the national standards of the National Park Service Vegetation Mapping Program. Accordingly, the vegetation classification follows the National Vegetation Classification (USNVC) hierarchy. The final vegetation map was developed at a 1:24,000 scale and with at least a 0.5-ha (1.2-acre) minimum map unit size. Map units were designed to support ecologically-based natural resource management with an emphasis on uses for fire, wildlife, and recreation management. The classification was based on an analysis of 540 field vegetation plots and classifies vegetation down to the plant association level of the US National Vegetation Classification (USNVC). Using the field vegetation plots as "training" samples, the map was developed using a combination of automated image analysis (image segmentation and supervised classifications) and direct image interpretation of 2004, 2008, 2014, and 2016 aerial imagery. An accuracy assessment based on 341 plots distrubuted in a stratified random design across the park was also conducted.

This report includes (1) details on the methods of vegetation classification and mapping; (2) an overview of the classification and ecology of the vegetation communities of the park; (3) the final vegetation map and accuracy assessment; (4) plant community descriptions and a diagnostic key; and (5) a vouchered species list. In addition, all field data have been compiled into a NPS PLOTS relational database according to NPS standards, and all spatial data and report elements have been made ready for web-based applications (https://www.nps.gov/im/vegetation-mapping-inventory.htm).

Park Environment

Location, Cultural Setting, and Environmental History

Guadalupe Mountains National Park is located in the western Trans-Pecos region of Texas, 100 miles (161 km) east of El Paso, TX, 55 miles (89 km) southwest of Carlsbad, NM, and just east of the town of Dell City, TX (Figure 2). The park was authorized by October 15, 1966 legislation "to preserve in public ownership an area possessing outstanding geological values together with scenic and other natural values of great significance," per Public Law 89-667 (NPS 2012).



Figure 1. The landscape of Guadalupe Mountains National Park extends from the desert basin floor—here looking northeast at Guadalupe Peak—to mountain tops that are among the tallest in Texas (2,667 m; 8,751 ft). Photo: NATURAL HERITAGE NEW MEXICO/C. JACKSON.

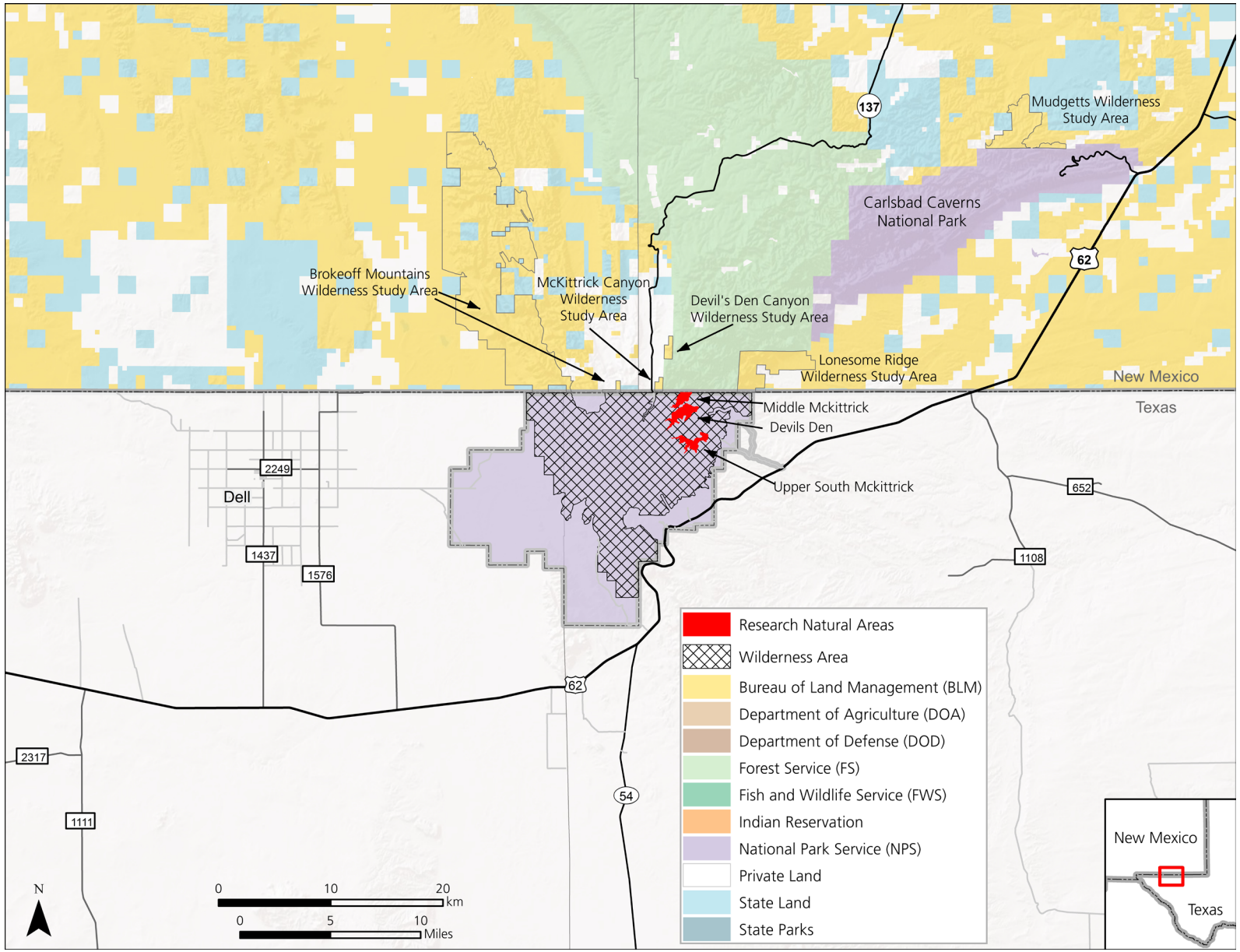


Figure 2. Guadalupe Mountains National Park is located about 177 km (110 miles) east of El Paso, Texas, along the New Mexico-Texas state line. The majority of the park is in designated wilderness and contains important Research Natural Areas along with wilderness study areas in the adjacent public lands in New Mexico.

The park was formally established on Sept. 30, 1972, and comprises 86,416 acres (34,973 ha), of which 46,850 acres (8,960 ha) are in a mountain wilderness that was designated in 1978, and 10,000 acres (4,050 ha) are part of a park expansion in 1988 to include the dune lands along the western boundary (Figure 3; NPS 2017). An additional 1,200 acres (489 ha) along its southern boundary are now provisionally included in the park. Within Texas, the park is surrounded by private land, mostly ranches or irrigated farmland. The park's northern edge lies along the Texas-New Mexico border and adjacent primarily to the Guadalupe District of the Lincoln National Forest. National Forest lands also lie between Guadalupe Mountains and Carlsbad Caverns national parks in New Mexico to the east, creating one of the larger contiguous blocks of public lands in the region, much of it wilderness or *de facto* wilderness.

The General Management Plan/Environmental Impact Statement (GMP) describes and delineates in detail both the natural and cultural resource values of the park (NPS 2012). In addition, a Natural Resources Condition Assessment (NRCA) further evaluates the ecological status of the park (Kilkus et al. 2013). The General Management Plan identified 13 Landscape Units for planning and management that correspond roughly to the major geomorphic/physiographic landscape elements of the park (Figure 4). In addition, six more broadly defined "Management Zones" were delineated to support park management (Designated Wilderness, Backcountry, Wilderness Threshold, Frontcountry, Developed, and Motorized Scenic Corridor).

The rugged interior highlands of High Mountain Country and Guadalupe Peak rise dramatically out of the desert basin floor units and range from 5,085 ft (1,550 m) at the mouth of McKittrick Canyon

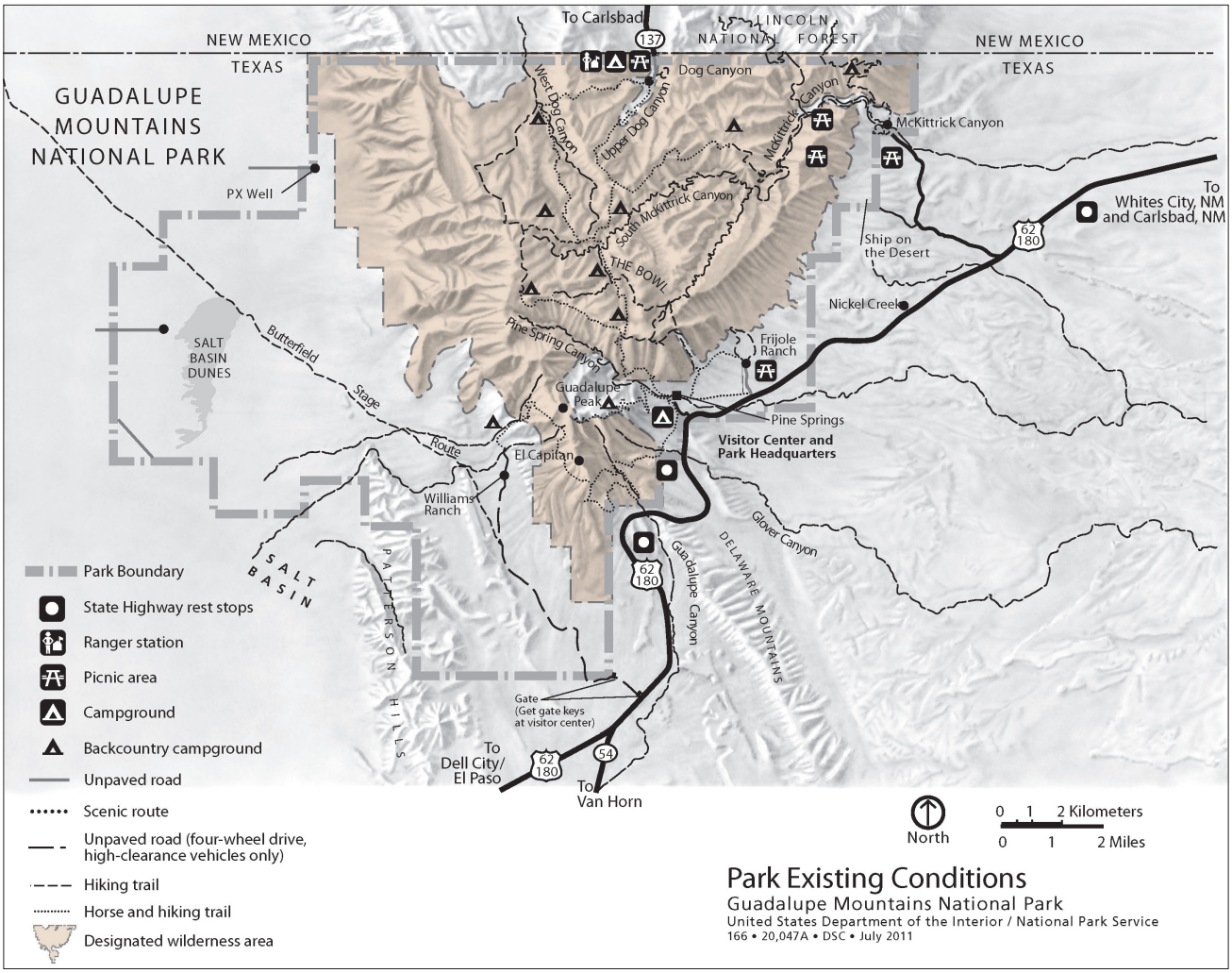


Figure 3. Guadalupe Mountains National Park facilities, roads, and trails (NPS 2012).

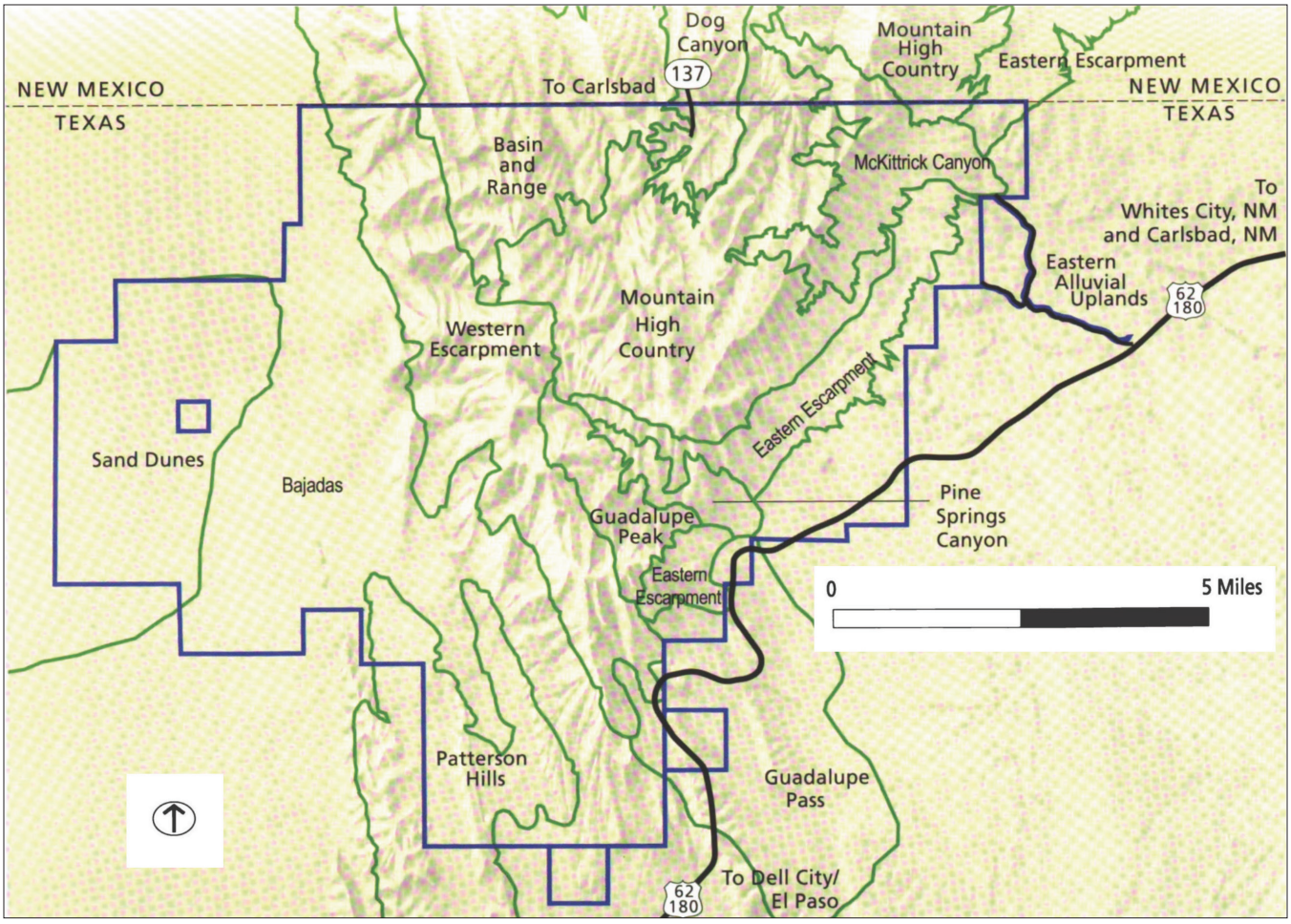


Figure 4. Landscape units of Guadalupe Mountains National Park, from the General Management Plan (NPS 2012).

to 8,751 ft (2,667 m) at the top of Guadalupe Peak and form the core of the park. The highlands are bordered by steep northwest-facing and northeast-facing escarpments (Western and Eastern Escarpments) that drop 3,280 ft (1,000 m) or more to the lower areas of the park. The Escarpments are skirted by the alluvial fans of the western Bajada and Eastern Foothills and are dissected by major drainages including McKittrick Canyon, Pine Canyon, Dog Canyon, and West Dog Canyon.

The Brokeoff Mountains of the Basin and Range unit and Patterson Hills are smaller and somewhat isolated, down-dropped fault block mountain ranges to the north and southwest, respectively. The western Sand Dunes occupy the lowest areas of the park (3,625 ft; 1105 m) and consist of the "White or Gypsum Dunes" and the "Red or Pink Dunes." The gypsum dunes consist of gypsum crystals ($CaSO_4$) resulting from mineral growth from sulfate-laden groundwater while the red dunes are siliciclasic sands (SiO_2) that are redeposited Permian sands eroded from the adjacent mountains. We refer to these landscape units when describing the distribution of vegetation elements across the park.

Cultural Elements

With respect to vegetation composition and pattern, the key cultural aspects of Guadalupe Mountains NP revolve around the American Indian influences and the impacts of Euro-American settlement. Up until Euro-Americans arrived in the region in the mid-1800s, the Guadalupe Mountains and surrounding lowlands were in the domain of the Mescalero Apache people (NPS 2012). Unlike other areas of the Southwest, the Spanish explorers passed through the area in the late 17th century but did not settle there. The Mescalero Apache likely used lower elevation springs and waterways and hunted the high country, but direct impacts on vegetation are not known. While the Apache may have influenced

the fire regime as suggested by Swetnam et al. (2001) elsewhere in the Southwest, it was not evident in the fire histories constructed from tree ring studies in the park (Ahlstrand 1982; Sakulich and Taylor 2007).

The successful military campaigns against the Mescalero Apache and the subsequent advent of Anglo-American livestock grazing in the mid-1880s likely had a direct impact on the desert grasslands and mountain areas with respect to species composition and fire frequencies. Ahlstrand (1982) suggests that increased shrub encroachment in the desert grasslands and lower grass cover in the high country was caused by grazing and led to lower fire frequencies. Sakulich and Taylor (2007) add that changing climate may have had an effect on reducing fires, but that the cessation of fire in the mountains after 1922 correlated with the introduction of livestock grazing (a water system was installed by J.C. Hunter in the 1920s to pipe water from lowland springs to high country; NPS 2012). Grazing removed the fine fuels that carried fire and it took nearly two decades after grazing ended for extensive fires to re-establish. All through the 1970s and 1980s, fires only burned a few acres to a few tens of acres. It was not until the 1990s that fires of more than 1000 acres (405 ha) burned in the park—specifically three fires that occurred in 1990, 1993, and 1994 were several thousand acres (Pers. Comm. J. Coles and Jonena Hearst, 2020). This caused increases in tree density during the 20th century and corresponding increases in fire hazards. Accordingly, the Guadalupe Mountain NP Fire Management Plan (NPS 2005, updated 2012) proposed a management strategy grounded in wildland fire use to re-establish pre-European settlement conditions.

Climate

The climate of Guadalupe Mountains NP is characterized by cool-to-cold, relatively dry winters and warm, wet (monsoonal) summers (Figure 5a) depending on elevation. Pine Springs, which is at mid-elevation near the visitor center, has average daily summer highs of around of 30°C (86°F) in the hottest months of June and July, while winter lows are near freezing at around -0.3°C (31.5°F) in the coldest months of December and January. Record temperature extremes range from 0°F (-18°C) in winter to 105°F (41°C) in summer, reflecting an essentially continental climate (Figure 5b).

Mean annual precipitation is 17.7 in (465 mm) with only 29% (5.11 in; 130 mm) of the precipitation in winter (October through March; Figure 6). This precipitation is delivered principally by low-pressure systems that sweep from west to east across the Southwest, coalescing with moisture from the Pacific Ocean or the Gulf of Mexico. Winter precipitation is generally followed by a seasonal dry period during the months of April and May. This dry period is defined as much by the increased potential evapotranspiration that accompanies increased day length, solar radiation, and temperatures, as by decreased precipitation. The spring dry period is usually relieved by the onset of the Mexican/Arizona monsoon from June through September, when total

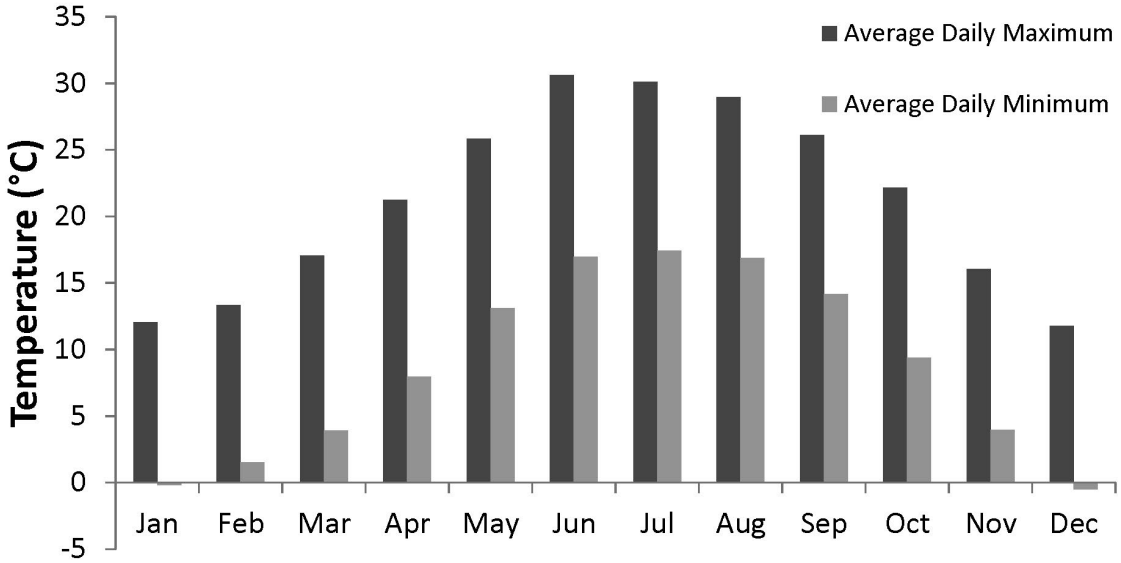


Figure 5a. Average monthly minimum and maximum daily temperatures at Pine Springs, Guadalupe Mountains National Park (Station USW00023055).

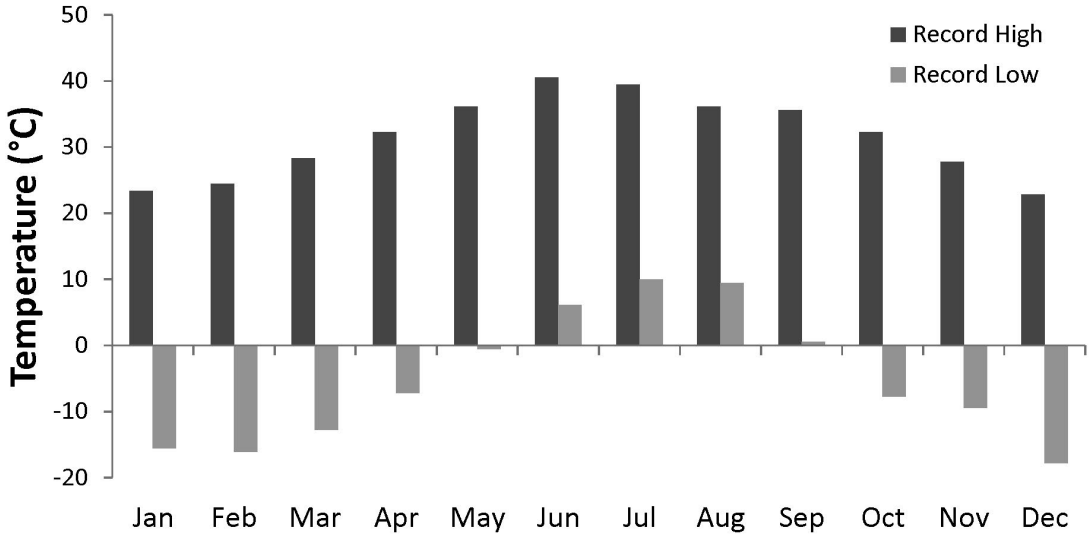


Figure 5b. Record monthly minimums and maximums at Pine Springs, Guadalupe Mountains NP (Station USW00023055).

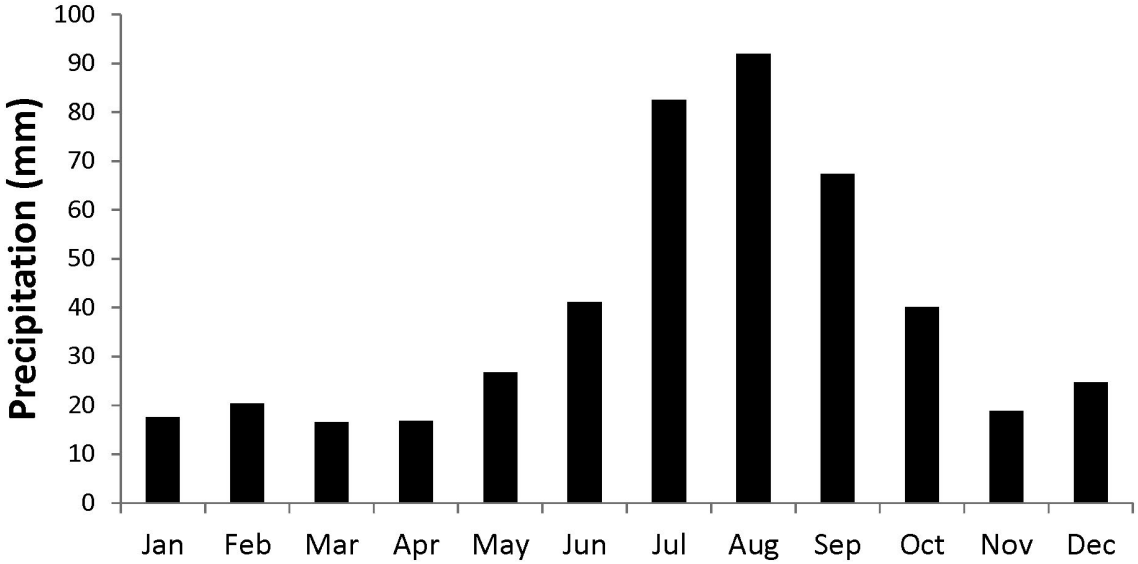


Figure 6. Average monthly precipitation distribution at Guadalupe Mountains National Park (Pine Springs, Station USW00023055). Summer rainfall predominates, but in any given year winter precipitation can be significant, particularly in years where the El Niño/Southern Oscillation (ENSO) index is positive (i.e., an El Niño year).

precipitation for these months averages 11.1 in (283 mm). This summer precipitation is associated mostly with short-duration, high-intensity thunderstorms and can be localized, leading to high year-to-year variability of precipitation over small areas. During project sampling years 2006 and 2007, annual and summer precipitation was above normal, averaging 21.2 in (539 mm) and 14.8 in (377 mm). In 2008, summer precipitation was below normal at 8.4 in (213 mm).

Geology and Soils

The original geologic map of the area was produced by Richardson (1904) followed by a more detailed map by P. B. King in 1948 (Figures 7a and 7b). In summary, the Guadalupe Mountains are primarily a limestone complex composed of an uplifted and tilted portion of an extensive carbonate reef system, the Permian Reef, that stretched for nearly 645 km (400 miles) around the Permian Delaware Basin and is found today primarily in the subsurface. The Western Escarpment marks easternmost extension of the Basin and Range physiographic province.

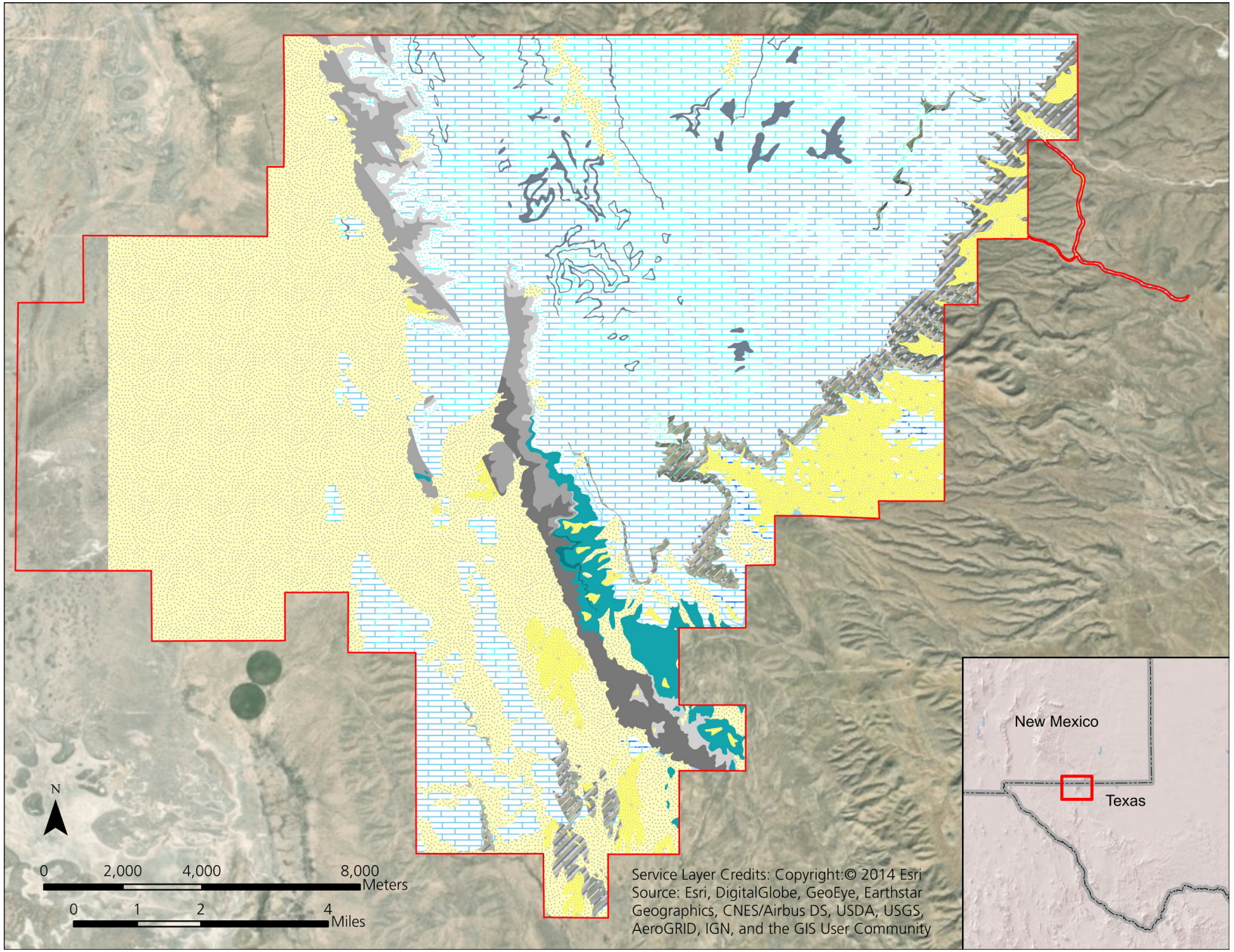


Figure 7a. The geological formations of Guadalupe Mountains National Park as mapped by King (1948). See Figure 7b for the map legend.

Geologic Map
Guadalupe Mountains National Park
Legend

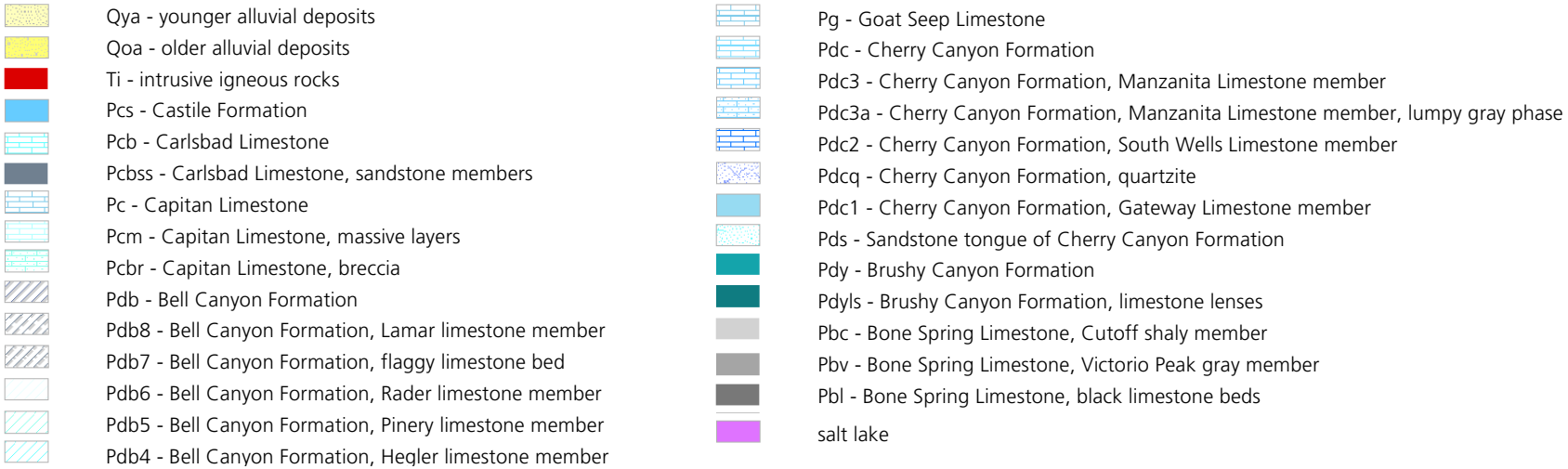


Figure 7b. Map legend for the geological formations of the Guadalupe Mountains National Park as mapped by King (1948). See Figure 7b for the map.

While the Delaware Basin is best known for the prolific oil or natural gas fields that line its margin, it is the carbonate platform that makes up the Guadalupe Mountains that is key to the landscape structure of Guadalupe Mountains NP (and for the caverns of neighboring Carlsbad Caverns NP). The reef system includes horizontal beds of the shallow shelf consisting of lagoonal and shoal sediments, the structureless reef (intact reef) and poorly-bedded forereef (reef-derived debris), and gently inclined to flat lying fine-grained basinal sediments of the deep ocean (Bebout and Kerans 1993). The Eastern Escarpment forms the eroded reef/forereef margin while the Western Escarpment represents an oblique cross-sectional view of the various units that made up the reef system that spans nearly 12 million years.

At the base of the escarpment extending westward into the lowland basin, King (1948) initially mapped broad categories of younger and older alluvial deposits and salt flats representing the broad alluvial fan piedmonts that rim the mountain base and the basin bottom sediments, respectively. He further subdivided the map into 18 surficial deposit units that separated out gypsum and quartz sand dunes, lacustrine (lake) deposits and alkali flats, as well as various alluvial fan and piedmont elements (Figure 8). For additional details on the geologic stratigraphy of Guadalupe Mountains NP, see Hayer (1964).

A recently completed soil map by Stahnke (2012) breaks out 14 map units representing 20 soil series in various combinations from the mountaintop to the basin floor (Figure 9; Table 1). There are eight lowland units that correspond somewhat to King's surficial units (type L in Table 1). Most of these were classified as Aridisols, or desert soils, while the upland soils were grouped as mostly Mollisols, or grassland/forest, soils. Stahnke (2012) provides detailed descriptions of the soils and interpretations for management. Here, we cross-reference the soils and geologic units with the vegetation classification and map we present and provide interpretation as needed in the context of the vegetation expression.

Previous Botanical and Vegetation Studies

Guadalupe Mountains NP straddles a northern boundary of the Chihuahuan Desert region as defined by Johnston (1979) and Henrickson and Johnston (1997), but contains several elements with Sierra Madrean, Rocky Mountain, and Great Plains affinities. Gehlbach (1967) provided the first quantitative analysis of vegetation types within the park, focusing on the escarpment. He described eight broad dominance types based primarily on tree and shrub importance that fell into five broad categories or *formations*: (1) a Shrub Desert dominated by *Larrea tridentata* (creosotebush), *Flourensia cernua* (tarbush), and *Vachellia neovernicosa* (viscid acacia); (2) Succulent Desert characterized by *Agave lechuguilla* (lechuguilla) along with *Juniperus pinchotii* (Pinchot's juniper) and *Viguiera stenoloba* (goldeneye); (3) Evergreen Woodland dominated by *Quercus grisea* (gray oak), *Juniperus deppeana* (alligator juniper), *Arbutus xalapensis* (Texas madrone), and *Pinus edulis* (pinyon pine); (4) Coniferous Forest characterized by *Pinus ponderosa* (ponderosa pine); and (5) a Deciduous Woodland dominated by riparian and semi-riparian species such as *Juglans microcarpa* (little walnut) and *Acer grandidentatum* (bigtooth maple).

Northington and Burgess (1979) also provided a review of the basic composition of vegetation in the Guadalupe Mountains that reiterates these patterns but additionally noted that rock outcrops supported a unique set of taxa warranting attention. In the same volume, Gehlbach (1979) presents a gradient analysis of his five formations but in the context of lizard habitat and succession following human disturbance. Fuller (1976) conducted a detailed analysis of landforms and watersheds within the park and in the process identified 68 dominance types based on observation points of the two dominant species in each. Bunting (1978) conducted a detailed analysis of vegetation and soils plus a map in the Guadalupe Mountains, primarily in Guadalupe Mountains NP (10 of his 195 plots were located in Carlsbad Caverns NP). Based on 190 plots, he described and mapped 65 plant communities into eight broad *associations*: Bolson, Gypsum, Quartz Sand, Creosotebush, Grassland, Mountain Shrub, Forest, and Canyon Terrace.

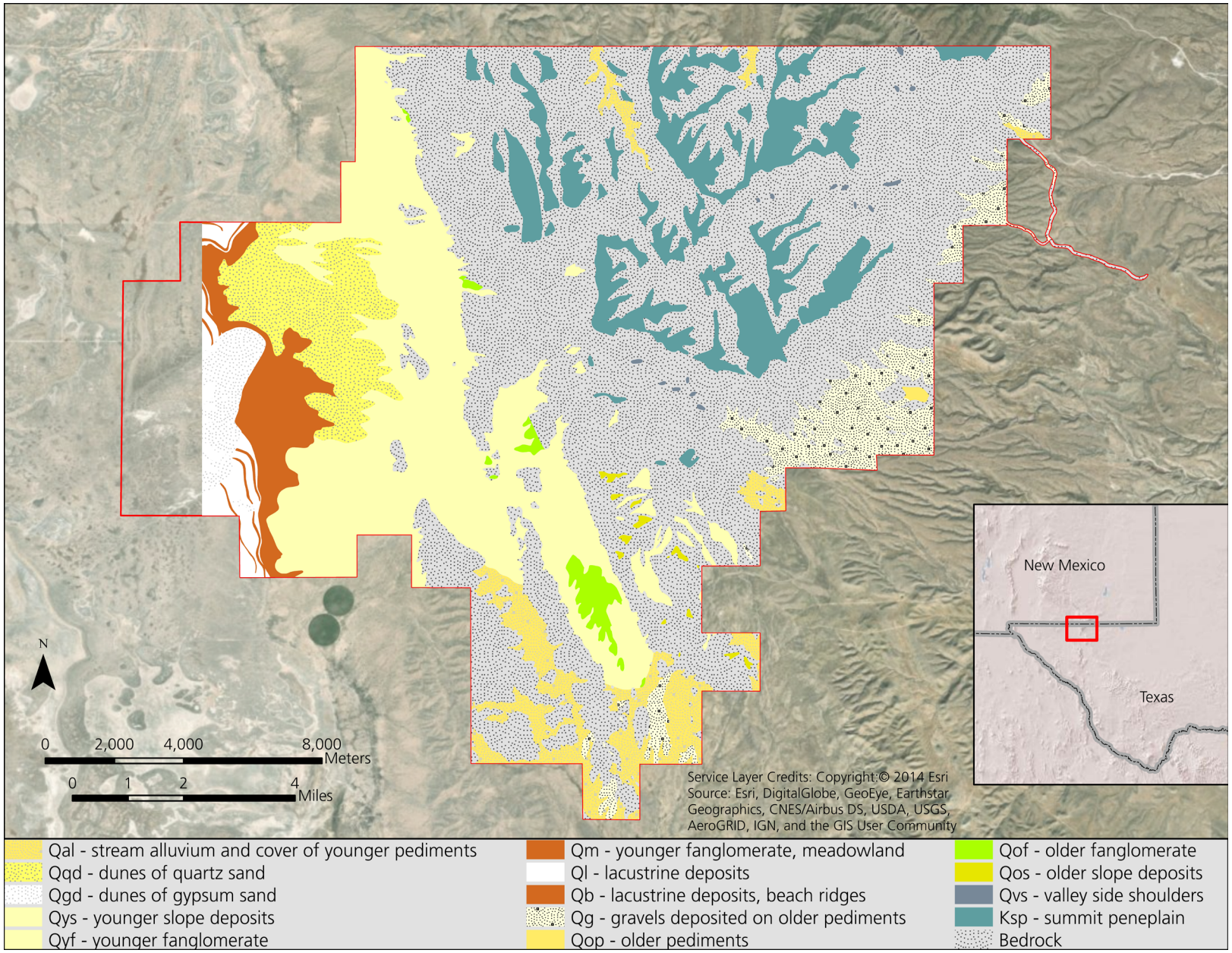


Figure 8. Surficial geology of Guadalupe Mountains National Park as mapped by King (1948).

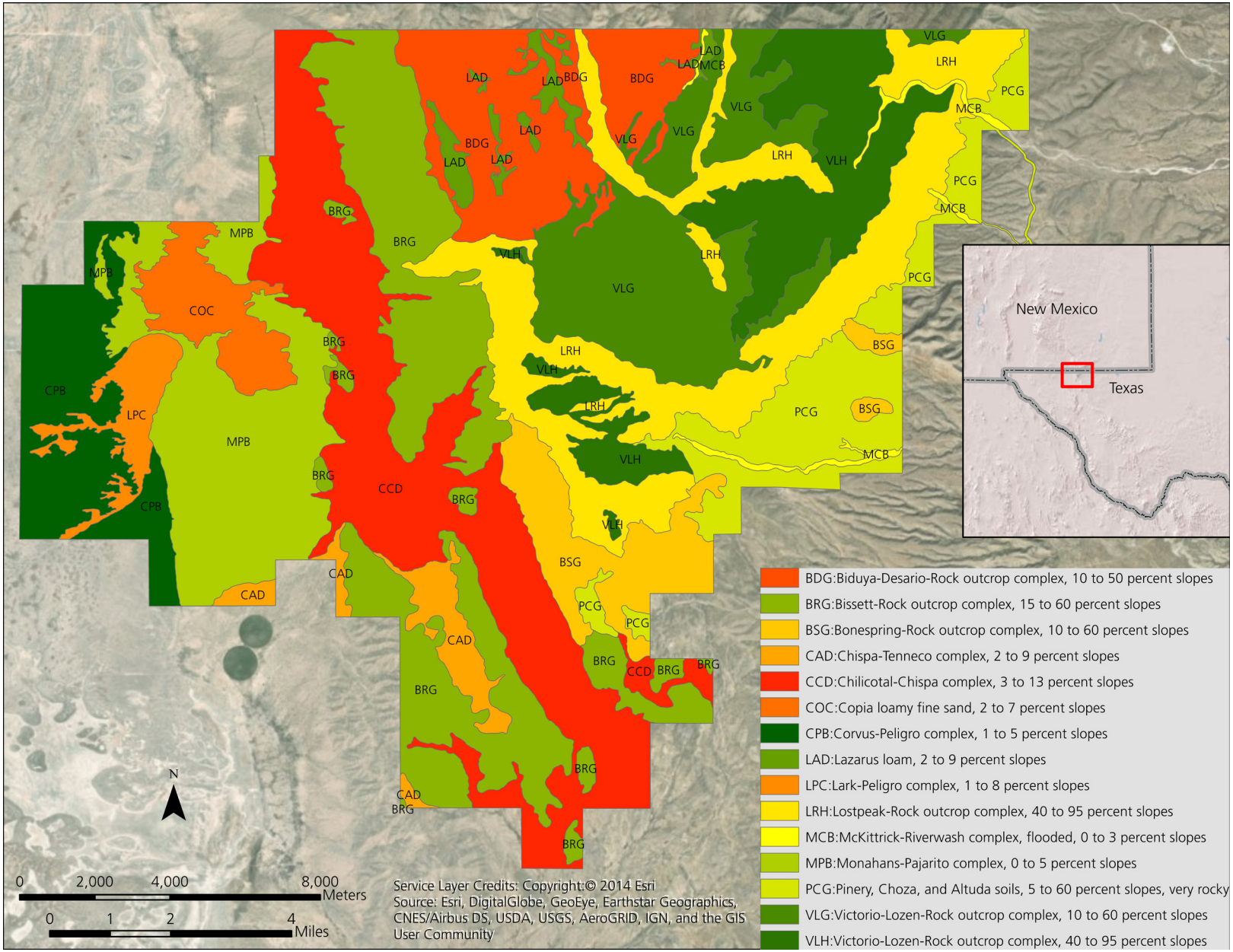


Figure 9. Soils of Guadalupe Mountains National Park as mapped by Stahnke (2012). See Table 1 for additional soils information.

Table 1. Soils map units for of Guadalupe National Park as mapped by Stahnke (2012).

Type	MU	MU name	Series	Family
H	BDG	Biduya-Desario-Rock outcrop complex, 10 to 50 percent slopes	Biduya	Loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls
H	BDG	Biduya-Desario-Rock outcrop complex, 10 to 50 percent slopes	Desario	Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls
H	BSG	Bonespring-Rock outcrop complex, 10 to 60 percent slopes	Bonespring	Loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents
H	LAD	Lazarus loam, 2 to 9 percent slopes	Lazarus	Fine-silty, mixed, superactive, mesic Pachic Argiustolls
H	LRH	Lostpeak-Rock outcrop complex, 40 to 95 percent slopes	Lostpeak	Loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls
H	MCB	McKittrick-Riverwash complex, flooded, 0 to 3 percent slopes	McKittrick, frequently flooded	Loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls
H	MCB	McKittrick-Riverwash complex, flooded, 0 to 3 percent slopes	McKittrick, occasionally flooded	Loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls
H	VLG	Victorio-Lozen-Rock outcrop complex, 10 to 60 percent slopes	Lozen	Loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls
H	VLG	Victorio-Lozen-Rock outcrop complex, 10 to 60 percent slopes	Victorio	Clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls
H	VLH	Victorio-Lozen-Rock outcrop complex, 40 to 95 percent slopes	Lozen	Loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls
H	VLH	Victorio-Lozen-Rock outcrop complex, 40 to 95 percent slopes	Victorio, 40 to 60 % slope	Clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls
H	VLH	Victorio-Lozen-Rock outcrop complex, 40 to 95 percent slopes	Victorio, 40 to 60 % slope	Clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls
H	VLH	Victorio-Lozen-Rock outcrop complex, 40 to 95 percent slopes	Victorio, 60 to 95 % slope	Clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls
L	BRG	Bissett-Rock outcrop complex, 15 to 60 percent slopes	Bissett	Loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids
L	CAD	Chispa-Tenneco complex, 2 to 9 percent slopes	Chispa	Fine-loamy, mixed, superactive, thermic Ustic Haplocalcids
L	CAD	Chispa-Tenneco complex, 2 to 9 percent slopes	Tenneco	Fine-loamy, mixed, superactive, thermic Ustic Haplocambids
L	CCD	Chilicotal-Chispa complex, 3 to 13 percent slopes	Chilicotal	Loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids
L	CCD	Chilicotal-Chispa complex, 3 to 13 percent slopes	Chispa	Fine-loamy, mixed, superactive, thermic Ustic Haplocalcids
L	COC	Copia loamy fine sand, 2 to 7 percent slopes	Copia	Mixed, thermic Typic Torripsamments
L	CPB	Corvus-Peligro complex, 1 to 5 percent slopes	Corvus	Loamy, hypergypsic, thermic, shallow Typic Petrogypsids
L	CPB	Corvus-Peligro complex, 1 to 5 percent slopes	Peligro	Coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids
L	LPC	Lark-Peligro complex, 1 to 8 percent slopes	Lark	Gypsic, thermic Typic Torripsamments
L	LPC	Lark-Peligro complex, 1 to 8 percent slopes	Peligro	Coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids
L	MPB	Monahans-Pajarito complex, 0 to 5 percent slopes	Monahans	Coarse-loamy, mixed, superactive, thermic Typic Calcigypsids
L	MPB	Monahans-Pajarito complex, 0 to 5 percent slopes	Pajarito	Coarse-loamy, mixed, superactive, thermic Typic Haplocambids
L	PCG	Pinery, Choza, and Altuda soils, 5 to 60 percent slopes, very rocky	Altuda	Loamy-skeletal, mixed, superactive, thermic Lithic Calciustolls
L	PCG	Pinery, Choza, and Altuda soils, 5 to 60 percent slopes, very rocky	Choza	Loamy-skeletal, mixed, superactive, thermic, shallow Petrocalcic Calciustolls
L	PCG	Pinery, Choza, and Altuda soils, 5 to 60 percent slopes, very rocky	Pinery	Loamy-skeletal, mixed, superactive, thermic Aridic Calciustolls

The Guadalupe Mountains NP GMP (NPS 2012) adopted the biome definitions and map of Brown et al. (1979) and Brown et al. (1994) and broadly mapped seven biotic communities for use in planning and management. These include lowland Chihuahuan Desert Scrub and Chihuahuan Semidesert Grassland of the desert basin up through Interior Chaparral, Madrean Evergreen Woodland, and Petran Montane Conifer Forest and Woodland at the higher elevations, plus Interior Riparian deciduous forest. Similarly, Dick-Peddie (1993) refers to these elements as Chihuahuan Desert Scrub, Desert Grassland, Montane Scrub, Mixed Woodland, Lower Montane Forest, and Montane Riparian. The park was also mapped as part of the National Gap Analysis Program (GAP; http://gapanalysis.usgs.gov) at a scale of about 1:100,000 using Thematic Mapper satellite imagery and the Ecological Systems Classification (Comer et al. 2003). This classification is similar in thematic resolution to that used in the GMP and also approximates the third level of the USNVC hierarchy used here (see Chapter 2). Texas Parks & Wildlife Department in collaboration with Missouri Resource Assessment Partnership is in the process of remapping the state at a similar scale to that of GAP (see Texas Ecological Systems Classification at https://morap.missouri.edu/index.php/texas-ecological-systems-classification/) .

Chapter 2: Vegetation Classification

A consistent, ecologically-based vegetation classification is the foundation for the development of an information–rich vegetation map. Vegetation classifications are ground-based descriptions of vegetation patterns that take into account floristic composition and abundance, site characteristics, and ecological dynamics. Accordingly, for Guadalupe Mountains NP, we used extensive field sampling and analysis to develop a hierarchical classification following the US National Vegetation Classification Standard (USNVCS; FGDC 2008). The outcome was the identification and description of a suite of plant associations that are singularly, or in combination, components of map units, depending on cartographic standards and constraints and the targeted uses of the map (see Chapter 3). Below we describe our methods for classification development and provide an overview and discussion of the Guadalupe Mountains classification.

Classification Methods

The National Vegetation Classification Standard

The classification system used in CHDN vegetation mapping projects is based on the NSNVCS adopted by the Federal Geographic Data Committee (FGDC) in 1997 and updated in 2008 (FGDC 1997; 2008). The 2008 revised standard adopted by the FGDC contains substantial revisions to the upper levels of the USNVCS hierarchy (Version 2; FGDC 2008) and now includes eight levels (Table 2). Per Jennings et al. (2009) and Faber-Langendoen et al. (2017), the upper three levels indicate physiognomic characteristics that reflect geographically widespread (global) topographic and edaphic factors. The middle three levels are new to the USNVCS hierarchy and focus on largely biogeographic and habitat factors along very broad, regional-to-continental topographic, edaphic, and disturbance gradients. The lower two levels, alliance and association, are distinguished by differences in floristic composition. Alliances are physiognomically distinct groups of plant associations sharing one or more differential or diagnostic species. These species are commonly the dominant(s) found in the uppermost strata of the vegetation. The plant association is the fundamental unit of the classification and, following the International Botanical Congress of 1910, is defined as a community of definite floristic composition (i.e., a repeating assemblage of species), uniform physiognomy, and habitat conditions. NPS classification and mapping follow the FGDC (2008) standard and focus on the group and plant association (PA) levels (here the alliance level was not used because it is currently provisionally defined and is under review). Global descriptions of units of classification are available at http://usnvc.org/explore-classification.

Field Methods

Vegetation sampling was designed to capture as wide a variety of vegetation types as possible within the seasonal time frame available for field work (typically during the rainy season between July 15 and October 15 when botanical expression is at its best). Sampling campaigns occurred between 2006 and 2010 and were planned to optimize field crew efficiency while still capturing as wide a range of vegetation types as possible on any given day. Accordingly, we used a cluster-sampling approach for which a series of daily routes for the sampling crews were designed in a Geographic Information System (GIS) using digital ortho-photography and preliminary vegetation maps. The locations of eight to ten sampling points per route were chosen based on differences in vegetation, soils, and geologic pattern, plus logistics (i.e., what could be accomplished in one day's travel time by foot by a field crew both on and off trail, and sampling days were ten hours long to further increase daily efficiency). Routes were distributed as widely as possible throughout the study area contingent on access from existing trails. Accordingly, large portions of the wilderness within the park were not accessible by foot, and aerial support was not provided. While the GIS was an excellent planning tool that took much of the guesswork out of plot placement, final plot locations were determined by field-based decisions predicated on positioning the sampling point in homogenous stands of vegetation and habitat.

Field crews were composed of three people; a senior technician responsible for botany and vegetation sampling and two junior technicians responsible for taking photographs and Global Positioning System (GPS) locations. Plots were established in large stands of vegetation representative of the typical vegetation at a site (greater than 0.5 ha; 1.2 acre).

Table 2. National Vegetation Classification hierarchy for terrestrial vegetation following the FGDC (2008) standard.

Hierarchy Level	Level	Level Name	Criteria	Example
Upper	L1	Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and/or substrate or aquatic conditions.	Mesomorphic Shrub and Herb Vegetation (Shrubland and Grassland)
	L2	Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate or aquatic conditions.	Temperate and Boreal Shrub and Herb Vegetation (Temperate and Boreal Shrubland & Grassland)
	L3	Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.	Temperate Shrub and Herb Vegetation (Temperate Shrubland & Grassland)
Mid	L4	Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant taxa that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon – Stipa – Bouteloua* Grassland & Shrubland Division (North American Great Plains Grassland & Shrubland)
	L5	Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and subcontinental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii – Schizachyrium scoparium –Sorghastrum nutans* Grassland & Shrubland Macrogroup (Great Plains Tall Grassland & Shrubland)
	L6	Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and codominants), broadly similar composition, and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii – Sporobolus heterolepis* Grassland Group (Great Plains Mesic Tallgrass Prairie)
Lower	L7	Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate substrates, hydrology, moisture/nutrient factors, and disturbance regimes.	*Andropogon gerardii – (Calamagrostis canadensis –Panicum virgatum)* Herbaceous Alliance (Wet-mesic Tallgrass Prairie)
	L8	Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii – Panicum virgatum – Helianthus grosseserratus* Herbaceous Vegetation (Central Wet-mesic Tallgrass Prairie)

Plots were generally 400 m² (4,305 ft²) and square, a standard size that Natural Heritage New Mexico (NHNM) uses in all its vegetation classification projects. It is a modification of the Daubenmire and Daubenmire (1968) sampling protocol used by the US Forest Service for forest and woodland sampling for classification purposes. Occasionally other sizes and shapes were used to fit the structure of a community, especially along drainages where vegetation stands conform to a channel shape.

For standard plots, a list of all vascular plant species was compiled and cover was estimated for each species using a modified Domin-Krajina Scale per Table 3 (Mueller-Dombois and Ellenberg 1974). The species list was stratified by life form of tree, shrub, subshrub, grass, and forb layers and height strata (< 0.5 m, 0.5 to 1.0 m. 1.0 m to 5.0 m, and > 5.0 m), and total non-overlapping cover was also recorded by stratum following FGDC (1997; 2008) guidelines (the exception was that *Pinus edulis*, *Juniperus monosperma*, and *Juniperus deapeeanna* were considered trees at >3 m and included in the cover estimation for that strata for characterization of low-statured pinyon-juniper woodlands). Site attributes, including slope, aspect, slope shape, surface rock type, and ground cover (percent rock, gravel, bare soil, and litter) were noted, along with narratives on species composition and site conditions. Plot locations were recorded with a Garmin GPS Model 12 with ± 10-m accuracy. For each plot, at least four photos were taken in the four cardinal directions from plot center, with each photo containing a placard noting the project, sampling date, and plot number. The compass direction and focal length of each shot was logged for future reference. The NHNM field-survey handbook provides examples of sampling forms, and detailed descriptions of sampling procedures (Muldavin et al. 2009).

We primarily used standard plots to support vegetation classification development, with three to five established in a day. To maximize ground control for the mapping process, we employed stripped-down mapping plots (quick plots) for which only the cover of dominant species in each stratum was recorded, along with a reduced set of site parameters. Anywhere from six to 12 of these quick plots were established in a day, depending on logistics. Lastly, we utilized simple observation points (OPs) for which we recorded GPS locations, plant association designation, and brief qualitative descriptions. In total, 540 plots were sampled between 2006 and 2010 for the classification and mapping portion of the project (Figure 10). Of these, 260 were standard plots, 265 were quick plots, and 15 were observation points.

Table 3. Modified Domin-Krajina Vegetation Cover Scale from Mueller-Dombois and Ellenberg (1974). Cover Class is the scalar value assigned in the field; Percent Canopy Cover is the range of cover the class represents; m²/400 m² is the actual area represented by the cover class within the 400 m² plot; and Midpoint % Cover is the midpoint canopy cover value used in data analysis.

Cover Class	Percent Canopy Cover	m²/400m²		Midpoint % Cover
		Min	Max	
+0	[Outside plot]	–	–	[0.001]
+	< 0.05	–	< 0.2	0.01
1	< 0.1	0.2	< 0.4	0.05
2	< 1	0.4	< 4	0.5
3	1–5	4	< 20	2.5
4	5–10	20	< 40	7.5
5	10–25	40	< 100	17.5
6	25–33	100	< 132	29.0
7	33–50	132	< 200	41.5
8	50–75	200	< 300	62.5
9	> 75	300	400	87.5

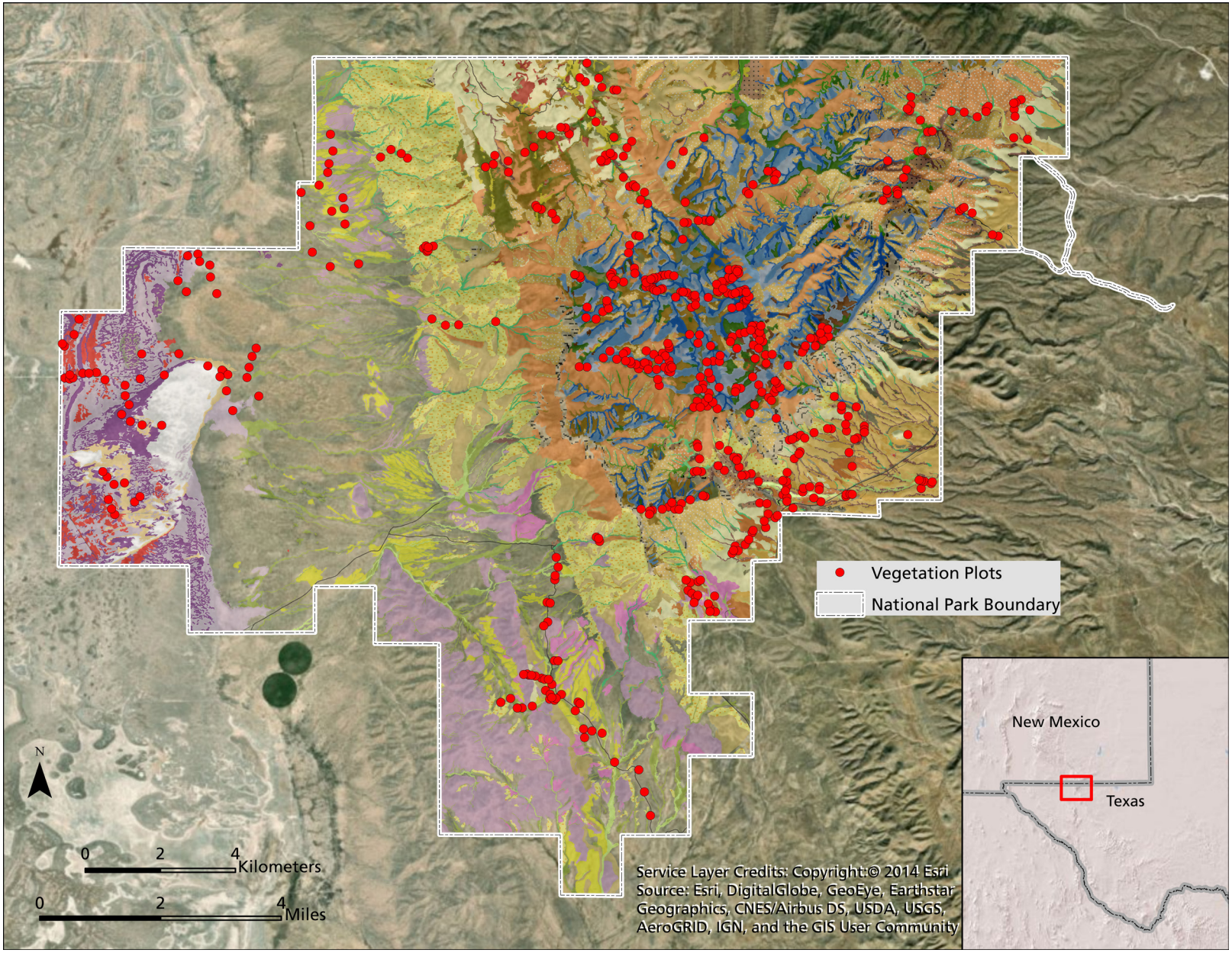


Figure 10. Distribution of 737 vegetation plots used in the development of the vegetation classification for Guadalupe Mountains National Park.

We collected plant voucher specimens to confirm field identifications when necessary. NHNM botanist Yvonne Chauvin identified specimens to the lowest level possible, given the material at hand, and assigned names according to the PLANTS database (USDA NRCS 2009) and the Integrated Taxonomic Information System (ITIS). Qualifying specimens were accessioned with both University of New Mexico (UNM) accession numbers and NPS record numbers tied to the herbarium and NPS databases. A species list derived from the plot data is provided in Appendix A.

All vegetation and site data were entered into the Microsoft Access NHNM Plot database and quality controlled through error-checking computer routines and manual read-backs. Each record contains the comprehensive documentation of the plot location, dimensions, vegetation composition, tree stand structure, site characteristics, vegetation classification, and photo points. All plot data and associated location information and metadata were transferred to a stand-alone NPS-developed Microsoft Access relational database (PLOTS v. 4.0). While no structural changes were made to the NPS database template, we did add selected fields that allow the tracking back of all data to the NHNM database.

Vegetation Analysis

To develop the vegetation classification, we used standard analytical techniques such as cluster analysis and tabular comparison coupled with ordinations (Becking 1957; Mueller-Dombois and Ellenberg 1974; Ludwig and Reynolds 1988; McCune and Grace 2002). These analyses were based primarily on species-level canopy-cover values with some grouping at the genus level where taxonomic units were ambiguous. Abundance scalar values were converted to percent cover mid-point values. Data describing site characteristics such as elevation, slope, aspect, and landform were used to supplement the analysis. In general, plots were grouped into plant associations (PAs), level seven of the FGDC (2008) hierarchical framework, based on codominance and/or groups of differential species that are diagnostic of differences between PAs based on the analysis (see Table 2). Where possible, plots were assigned to pre-existing USNVC associations based on the descriptions provided at the US National Vegetation Classification website (USNVC.org).

Associations were assigned to groups, Level 5 of the USNCV, which are then linked to Level 4 macrogroups and so on up the hierarchy outlined in Table 2. Narrative descriptions were written for local associations, groups, and macrogroups based on the plot data floristic composition and environmental factors. The USNVC continues to be revised and not all groups have been defined. Hence, we had the opportunity here to propose new groups for review as part of the analysis. Final summary floristic and site tables by plant association were computed and were the basis for plant association descriptions and dichotomous keys.

Classification Results

The vegetation of Guadalupe Mountains NP is diverse and reflects the strong elevation gradient and topographic complexity of the park as well as its location at the southern end of the Rocky Mountains and within the transition to the Sierra Madre Orientale of Mexico. Accordingly, we identified 129 PAs among 29 groups of the USNVC, making Guadalupe Mountains one of the most botanically diverse national parks in the United States. In Tables 4A–4L, we present the PAs ordered by USNVC hierarchy along with their classification status, number of plots in the park, and NatureServe database code. “Code” is either the NatureServe national database code (CEGL numbers) for established PAs or NHNM code (NPS or NHNM codes) for provisional ones. Of these, 35 were considered established associations according to the USNVC (i.e., they are well documented either in the park or in the region and have been entered in the USNVC database and assigned database codes as standard associations). The remaining 94 are provisional plant associations pending review for inclusion in the USNVC. They have been assigned a provisional NHNM database code pending acceptance into the USNVC. We provide local plant association descriptions of floristic composition site characteristics in Appendix C, and diagnostic keys in Appendix B. We have cross-walked each PA to the map units in the vegetation map legend. See Chapter 3 for a description of map unit structure and Appendix D for the crosswalk to map legend.

Table 4A. Guadalupe Mountains NP vegetation classification for the 1.B.1.Nd Madrean-Balconian Forest & Woodland Division (Class 1 Forest & Woodland; Subclass 1.B Temperate & Boreal Forest & Woodland; Formation 1.B.1 Warm Temperate Forest & Woodland. See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M010. Madrean Lowland Evergreen Woodland	G201. Madrean Encinal Group	*Quercus grisea - Arbutus xalapensis* Woodland	5	CEPP007103	4B
	G201. Madrean Encinal Group	*Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	11	CEPP007106	4A, 4B
	G201. Madrean Encinal Group	*Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora* Woodland	7	CEPP007144	4B
	G201. Madrean Encinal Group	*Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum* Woodland	1	CEPP007146	4B
	G487. Madrean Juniper Open Woodland Group	*Juniperus deppeana / Bouteloua gracilis* Woodland	1	CEGL000693	3B
	G487. Madrean Juniper Open Woodland Group	*Juniperus deppeana / Muhlenbergia pauciflora* Woodland	6	CEPP006891	3A
	G487. Madrean Juniper Open Woodland Group	*Juniperus deppeana / Quercus* x *pauciloba / Bouteloua curtipendula* Woodland	10	CEPP006892	3C, 4A
	G200. Madrean Pinyon - Juniper Woodland Group	*Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum* Woodland	3	CEPP006947	3A
	G200. Madrean Pinyon - Juniper Woodland Group	*Pinus edulis / Muhlenbergia pauciflora* Woodland	6	CEGL000785	3A
	G200. Madrean Pinyon - Juniper Woodland Group	*Pinus edulis / Muhlenbergia setifolia* Woodland	2	CEPP006971	3A
	G200. Madrean Pinyon - Juniper Woodland Group	*Pinus edulis / Nassella tenuissima* Woodland	3	CEPP006972	3B
	G200. Madrean Pinyon - Juniper Woodland Group	*Pinus edulis / Quercus* x *pauciloba (Cercocarpus montanus* var. *paucidentatus) / Muhlenbergia pauciflora* Woodland	22	CEPP006977	3C
M011. Madrean Montane Forest & Woodland	G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group	*Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii* Forest	2	CEPP006978	2B
	G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group	*Pinus ponderosa / Muhlenbergia pauciflora* Forest	5	CEPP006980	2A
	G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group	*Pinus ponderosa / Quercus* x *pauciloba / Muhlenbergia pauciflora* Forest	12	CEPP006982	1A
	G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group	*Pinus ponderosa / Quercus* x *pauciloba / Piptochaetium fimbriatum* Forest	3	CEPP006983	1A
	G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group	*Pinus ponderosa / Quercus gambelii / Piptochaetium fimbriatum* Forest	5	CEPP006981	2A

Table 4A (continued). Guadalupe Mountains NP vegetation classification for the 1.B.1.Nd Madrean-Balconian Forest & Woodland Division (Class 1 Forest & Woodland; Subclass 1.B Temperate & Boreal Forest & Woodland; Formation 1.B.1 Warm Temperate Forest & Woodland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M011. Madrean Montane Forest & Woodland (continued)	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Acer grandidentatum - Quercus grisea* Forest	1	CEPP006870	13A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Acer grandidentatum - Quercus muehlenbergii* Forest	10	CEGL004547	1C, 2B, 13A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii* Forest	3	CEPP006984	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pinus strobiformis - Acer grandidentatum - Quercus gambelii* Forest	2	CEPP006985	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii* Forest	6	CEPP006986	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pinus strobiformis - Quercus muehlenbergii* Forest	2	CEPP006987	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pinus strobiformis / Festuca arizonica* Forest	3	CEPP006988	1A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Populus tremuloides - Pinus strobiformis / Ostrya knowltonii* Forest	2	CEPP006991	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii* Forest	2	CEPP006993	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii* Forest	7	CEPP006994	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii* Forest	8	CEPP006995	1C
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Ostrya knowltonii* Forest	8	CEPP006996	1B
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest	38	CEPP006997	1B
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica* Forest	11	CEPP006998	1A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest	7	CEPP006999	1A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum* Forest	5	CEPP007000	1A
	G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group	*Pseudotsuga menziesii / Muhlenbergia pauciflora* Forest	6	CEPP007098	1A

Table 4B. Guadalupe Mountains NP vegetation classification for the 1.B.2.Nb Rocky Mountain Forest & Woodland Division (Class 1 Forest & Woodland; Subclass 1.B Temperate & Boreal Forest & Woodland; Formation 1.B.2 Cool Temperate Forest & Woodland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to describe PA	Code	Map Units Where PA Occurs
M020. Rocky Mountain Subalpine - High Montane Forest	G222. Rocky Mountain Subalpine - Montane Aspen Forest & Woodland Group	*Acer grandidentatum* / *Quercus gambelii* Forest	4	CEGL000559	1C, 2B
M022. Southern Rocky Mountain Lower Montane Forest	G229. Southern Rocky Mountain Ponderosa Pine Open Woodland Group	*Pinus ponderosa - Quercus gambelii* / *Festuca arizonica* Forest	1	CEPP006979	2A

Table 4C. Guadalupe Mountains NP vegetation classification for the 1.B.2.Nc Western North American Pinyon - Juniper Woodland & Scrub Division (Class 1 Forest & Woodland; Subclass 1.B Temperate & Boreal Forest & Woodland; Formation 1.B.2 Cool Temperate Forest & Woodland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M027. Southern Rocky Mountain - Colorado Plateau Two-needle Pinyon - Juniper Woodland	G253. Southern Rocky Mountain Pinyon - Juniper Woodland Group	*Pinus edulis - (Juniperus monosperma, Juniperus deppeana)* / *Bouteloua gracilis* Open Woodland	1	CEGL002151	3B

Table 4D. Guadalupe Mountains NP vegetation classification for the 1.B.3.Nd Western North American Interior Flooded Forest Division (Class 1 Forest & Woodland; Subclass 1.B Temperate & Boreal Forest & Woodland; Formation 1.B.3 Temperate Flooded & Swamp Forest). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to describe PA	Code	Map Units Where PA Occurs
M036. Interior Warm & Cool Desert Riparian Forest	G797. Western Interior Riparian Forest & Woodland	*Populus deltoides* / *Muhlenbergia asperifolia* Flooded Forest	1	CEGL000678	13A

Table 4E. Guadalupe Mountains NP vegetation classification for the 2.B.2.Na Western North American Grassland & Shrubland Division (Class 2 Shrub & Herb Vegetation; Subclass 2.B Temperate & Boreal Grassland & Shrubland; Formation 2.B.2 Temperate Grassland & Shrubland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M168. Rocky Mountain - Vancouverian Subalpine - High Montane Mesic Meadow	G268. Southern Rocky Mountain Montane - Subalpine Grassland Group	*Festuca arizonica - Bouteloua gracilis* Grassland	1	CEPP006886	7A
	G268. Southern Rocky Mountain Montane - Subalpine Grassland Group	*Achnatherum lobatum - Bouteloua curtipendula* Grassland	2	CEPP006871	7B
M049. Southern Rocky Mountain Montane Shrubland	G276. Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group	*Quercus* x *pauciloba / Cercocarpus montanus* Shrubland	6	CEGL001118	6B
	G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group	*Quercus gambelii / Carex inops* Shrubland	3	CEGL001112	5A
	G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group	*Quercus gambelii / Piptochaetium fimbriatum - Festuca arizonica* Woodland	3	CEPP007101	5A
	G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group	*Quercus gambelii / Robinia neomexicana* Shrubland	7	CEGL001115	5A
	G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group	*Robinia neomexicana / Piptochaetium fimbriatum* Shrubland	2	CEPP007155	5A

Table 4F. Guadalupe Mountains NP vegetation classification for the 2.B.2.Nb Central North American Grassland & Shrubland Division (Class 2 Shrub & Herb Vegetation; Subclass 2.B Temperate & Boreal Grassland & Shrubland; Formation 2.B.2 Temperate Grassland & Shrubland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M053. Western Great Plains Shortgrass Prairie	G144. Great Plains Shortgrass Prairie Group	*Bouteloua gracilis - Bouteloua curtipendula* Grassland	5	CEGL001754	7C, 7G
	G144. Great Plains Shortgrass Prairie Group	*Bouteloua gracilis* Ruderal Grassland	1	CEPS009501	15A
	G144. Great Plains Shortgrass Prairie Group	*Bouteloua hirsuta - Bouteloua curtipendula* Grassland	0	CEGL001764	7C

Table 4G. Guadalupe Mountains NP vegetation classification for the 2.B.2.Nd Western North American Interior Chaparral Division (Class 2 Shrub & Herb Vegetation; Subclass 2.B Temperate & Boreal Grassland & Shrubland; Formation 2.B.2 Temperate Grassland & Shrubland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M091. Warm Interior Chaparral	G281. Western Madrean Chaparral Group	*Cercocarpus montanus* / *Muhlenbergia pauciflora* Shrubland	16	CEGL001089	6C
	G280. Eastern Madrean Chaparral Group	*Cercocarpus montanus* / *Muhlenbergia setifolia* Shrubland	3	CEPP006879	6C
	G280. Eastern Madrean Chaparral Group	*Juniperus pinchotii* / *Quercus (pungens,* x *pauciloba)* / *Muhlenbergia setifolia* Woodland	10	CEPP006893	6A
	G280. Eastern Madrean Chaparral Group	*Quercus* x *pauciloba* / *Achnatherum lobatum* Shrubland	3	CEPP007153	6B
	G280. Eastern Madrean Chaparral Group	*Quercus (pungens,* × *pauciloba)* / *Muhlenbergia emersleyi* Shrubland	10	CEPP007148	6D
	G280. Eastern Madrean Chaparral Group	*Quercus (pungens,* × *pauciloba)* / *Muhlenbergia pauciflora* Shrubland	28	CEPP007149	6B
	G280. Eastern Madrean Chaparral Group	*Quercus pungens* / *Bouteloua gracilis* Shrubland	2	CEPP007150	6D
	G280. Eastern Madrean Chaparral Group	*Quercus pungens* / *Muhlenbergia setifolia* Shrubland	1	CEPP007152	6A

Table 4H. Guadalupe Mountains NP vegetation classification for the 2.C.4.Nb Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (Class 2 Shrub & Herb Vegetation; Subclass 2.C Shrub & Herb Wetland; Formation 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M888. Arid West Interior Freshwater Marsh	G531. Arid West Interior Freshwater Marsh Group	*Schoenoplectus americanus* Western Marsh	1	CEGL001841	14A

Table 4I. Guadalupe Mountains NP vegetation classification for the 2.C.5.Nd North American Western Interior Brackish Marsh, Playa & Shrubland Division (Class 2 Shrub & Herb Vegetation; Subclass 2.C Shrub & Herb Wetland; Formation 2.C.5 Salt Marsh). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M082. Warm & Cool Desert Alkali - Saline Marsh, Playa & Shrubland	G538. North American Desert Alkaline - Saline Marsh & Playa Group	*Sporobolus airoides* Monotype Wet Meadow	2	CEGL001688	8B, 9B, 11B

Table 4J. Guadalupe Mountains NP vegetation classification for the 3.A.2.Na North American Warm Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland; Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definition sand Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M086. Chihuahuan Desert Scrub	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Acacia neovernicosa* / *Bouteloua eriopoda* Shrubland	3	CEPP006869	11A
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Flourensia cernua* / *Muhlenbergia porteri* Shrubland	2	CEPP007428	12C
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* - *Flourensia cernua* Sparse Shrubland	1	CEPP006895	11C, 12C
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* - *Krameria grayi* Shrubland	2	CEPP006896	11C
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* - *Parthenium incanum* Shrubland	4	CEGL001274	11C
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* / *Bouteloua eriopoda* Shrubland	5	CEGL001265	11C, 11D
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* / *Bouteloua gracilis* Shrubland	1	CEGL001266	11D
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* / *Muhlenbergia porteri* Shrubland	5	CEGL001272	11D, 12C
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Larrea tridentata* / Sparse Understory Shrubland	4	CEGL001276	11C, 11D
	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Mortonia scabrella* - *Parthenium incanum* Shrubland	1	CEPP006899	10A

Table 4J (continued). Guadalupe Mountains NP vegetation classification for the 3.A.2.Na North American Warm Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland; Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M086. Chihuahuan Desert Scrub (continued)	G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group	*Viguiera stenoloba / Parthenium incanum* Shrubland	2	CEPP007514	10A
	G299. Chihuahuan Desert Lowland Basin Scrub Group	*Prosopis glandulosa / Sporobolus airoides* Shrubland	1	CEGL001385	11E
	G299. Chihuahuan Desert Lowland Basin Scrub Group	*Larrea tridentata / Sporobolus airoides* Shrubland	1	CEGL001277	11C
	G287. Chihuahuan Desert Sand Scrub Group	*Atriplex canescens / Sporobolus (flexuosus, cryptandrus, contractus*) Shrubland	2	CEPP006874	11B
	G287. Chihuahuan Desert Sand Scrub Group	*Larrea tridentata / Sporobolus flexuosus* Shrubland	2	CEPP006897	11C
	G287. Chihuahuan Desert Sand Scrub Group	*Poliomintha incana / Sporobolus flexuosus* Shrubland	1	CEPP006990	9A
	G287. Chihuahuan Desert Sand Scrub Group	*Psorothamnus scoparius / Sporobolus flexuosus* Shrubland	3	CEGL001695	11E
	G286. Chihuahuan Desert Succulent Scrub Group	*Acacia neovernicosa - Agave lechuguilla* Shrubland	1	CEPP006868	11A
	G286. Chihuahuan Desert Succulent Scrub Group	*Fouquieria splendens - Tiquilia greggii* Shrubland	6	CEPP006887	10A
	G286. Chihuahuan Desert Succulent Scrub Group	*Fouquieria splendens / Parthenium incanum* Shrubland	3	CEGL001378	10A
	G847. Chihuahuan Gypsophilous Scrub Group	*Atriplex canescens / Muhlenbergia porteri - Sartwellia flaveriae* Shrubland	4	CEPP006873	9B
	G847. Chihuahuan Gypsophilous Scrub Group	*Atriplex canescens / Sporobolus airoides / Sartwellia flaveriae* Shrubland	6	CEPP006875	9B
	G847. Chihuahuan Gypsophilous Scrub Group	*Atriplex canescens / Sporobolus nealleyi* Shrubland	2	CEPP007287	9B
	G847. Chihuahuan Gypsophilous Scrub Group	*Poliomintha incana / Andropogon hallii* Shrubland	1	CEPP006989	9A
	G847. Chihuahuan Gypsophilous Scrub Group	*Poliomintha incana / Bouteloua breviseta* Gypsophilous Shrubland	1	CEPP007438	9A
M087. Chihuahuan Semi-Desert Grassland	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Agave lechuguilla / Bouteloua eriopoda* Dwarf-shrubland	1	CEPP006872	7I
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Bouteloua eriopoda - Bouteloua curtipendula* Grassland	4	CEGL001747	7I
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Bouteloua eriopoda - Bouteloua gracilis* Grassland	9	CEGL001748	7G, 7H

Table 4J (continued). Guadalupe Mountains NP vegetation classification for the 3.A.2.Na North American Warm Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland; Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M087. Chihuahuan Semi-Desert Grassland (continued)	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Bouteloua eriopoda - Hesperostipa neomexicana* Grassland	1	CEGL001753	7H
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Bouteloua eriopoda - Muhlenbergia porteri* Grassland	1	CEPP006877	7I
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Dasylirion leiophyllum - Agave lechuguilla / Muhlenbergia setifolia* Shrub Grassland	1	CEPP006881	7D
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Dasylirion leiophyllum / Bouteloua curtipendula* Shrub Grassland	3	CEPP006882	7E
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Dasylirion leiophyllum / Muhlenbergia emersleyi* Shrub Grassland	3	CEPP006883	7E
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Dasylirion leiophyllum / Muhlenbergia setifolia* Shrub Grassland	11	CEPP006884	7D
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Fouquieria splendens / Bouteloua curtipendula* Shrub Grassland	2	CEPP006888	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Fouquieria splendens / Bouteloua eriopoda* Shrub Grassland	1	CEPP006889	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Hesperostipa neomexicana - Bouteloua curtipendula* Grassland	1	CEGL001709	7B
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Hesperostipa neomexicana - Dasylirion wheeleri* Grassland	2	CEGL001710	7E
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Krameria grayi / Dasyochloa pulchella* Dwarf-shrub Grassland	2	CEPP006894	7I
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Mimosa aculeaticarpa* var. *biuncifera / Bouteloua curtipendula* Shrub Grassland	4	CEPP006898	7J
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Muhlenbergia setifolia - Bouteloua eriopoda* Grassland	3	CEPP006930	7H
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Nassella tenuissima - Bouteloua gracilis* Grassland	5	CEPP006931	7C
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Nolina (texana, microcarpa) / Bouteloua eriopoda* Shrub Grassland	1	CEPP006932	7E

Table 4J (continued). Guadalupe Mountains NP vegetation classification for the 3.A.2.Na North American Warm Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland; Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M087. Chihuahuan Semi-Desert Grassland (continued)	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Nolina (texana, microcarpa) / Muhlenbergia emersleyi* Shrub Grassland	1	CEPP006933	7E
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Nolina (texana, microcarpa) / Muhlenbergia setifolia* Shrub Grassland	5	CEPP006934	7D
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Parthenium incanum / Bouteloua eriopoda* Shrub Grassland	5	CEGL001734	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Setaria leucopila / Solanum elaeagnifolium* Grassland	3	CEPP007484	15A
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Viguiera stenoloba / Bouteloua curtipendula* Shrub Grassland	4	CEPP007492	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Viguiera stenoloba / Bouteloua eriopoda* Shrub Grassland	4	CEPP007501	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Viguiera stenoloba / Muhlenbergia pauciflora* Shrub Grassland	2	CEPP007506	7E
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Viguiera stenoloba / Bouteloua gracilis* Shrub Grassland	2	CEPP007516	7F
	G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group	*Yucca torreyi / Bouteloua eriopoda* Shrub Grassland	2	CEPP007523	7I
	G492. Chihuahuan Gypsophilous Grassland Group	*Ephedra torreyana / Bouteloua breviseta* Dwarf-shrub Grassland	4	CEPP007425	8A
	G492. Chihuahuan Gypsophilous Grassland Group	*Sporobolus nealleyi - Sporobolus airoides* Grassland	5	CEPP007465	8B
	G492. Chihuahuan Gypsophilous Grassland Group	*Tiquilia hispidissima / Bouteloua breviseta - Sporobolus nealleyi* Shrub Grassland	3	CEPP007487	8A
	G492. Chihuahuan Gypsophilous Grassland Group	*Tiquilia hispidissima / Dasyochloa pulchella* Dwarf-shrub Grassland	1	CEPP007490	7I
	G492. Chihuahuan Gypsophilous Grassland Group	*Tiquilia hispidissima / Sartwellia flaveriae* Dwarf-shrubland	3	CEPP007491	8C
	G492. Chihuahuan Gypsophilous Grassland Group	*Tiquilia hispidissima / Sporobolus nealleyi* Dwarf-shrubland	7	CEGL001546	8C

Table 4J (continued). Guadalupe Mountains NP vegetation classification for the 3.A.2.Na North American Warm Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland; Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M087. Chihuahuan Semi-Desert Grassland (continued)	G491. Chihuahuan Sandy Plains Semi-Desert Grassland Group	*Yucca elata* / *Bouteloua eriopoda* - *Bouteloua gracilis* Shrub Grassland	2	CEPP007518	7H
	G491. Chihuahuan Sandy Plains Semi-Desert Grassland Group	*Yucca elata* / *Bouteloua eriopoda* Shrub Grassland	3	CEGL001735	7G, 7H
	G491. Chihuahuan Sandy Plains Semi-Desert Grassland Group	*Yucca elata* / *Bouteloua gracilis* Shrub Grassland	1	CEPP007520	7H
	G489. Chihuahuan Semi-Desert Lowland Grassland Group	*Bouteloua gracilis* - *Panicum obtusum* Grassland	3	CEPP006878	7C
M092. North American Warm-Desert Xeric - Riparian Scrub	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Chilopsis linearis* - *Fallugia paradoxa* Desert Wash Shrubland	1	CEPP006880	12B
	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Fallugia paradoxa* / *Ungnadia speciosa* Shrubland	2	CEGL002719	12A
	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Fallugia paradoxa* Desert Wash Shrubland	7	CEGL002716	12B
	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Fallugia paradoxa* - *Brickellia laciniata* Desert Wash Shrubland	3	CEPP006885	12B
	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Prosopis glandulosa* Desert Wash Shrubland	1	CEPP006992	12C
	G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group	*Juglans microcarpa* - *Fallugia paradoxa* / *Bouteloua curtipendula* Desert Wash Shrubland	2	CEPP006890	12B
M512. North American Warm Desert Ruderal Scrub & Grassland	G819. North American Warm Desert Ruderal Scrub Group	*Prosopis glandulosa* / *Sporobolus flexuosus* Ruderal Shrubland	1	CEGL001386	11E

Table 4K. Guadalupe Mountains NP vegetation classification for the 3.B.1.Ne Western North American Cool Semi-Desert Scrub & Grassland Division (Class 3 Desert & Semi-Desert; Subclass 3.B Cool Semi-Desert Scrub & Grassland; Formation 3.B.1 Cool Semi-Desert Scrub & Grassland). See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
M093. Great Basin Saltbush Scrub	G300. Intermountain Shadscale - Saltbush Scrub Group	*Atriplex canescens* / *Sporobolus airoides* Shrubland	3	CEGL001291	11B

Table 4L. Guadalupe Mountains NP vegetation classification for Miscellaneous Southwest Herbaceous Vegetation. See Table 2 for USNVC hierarchical level definitions and Chapter 3 for map unit definitions.

Macrogroup	Group	Plant Association (PA)	# Plots Used to Describe PA	Code	Map Units Where PA Occurs
MSWU. Miscellaneous Southwest Herbaceous Vegetation	–	Disturbed / Tank	1	NHNM000397	15A

Classification Overview

Following the structure of the classification in Tables 4A-4L but focusing on the macrogroup and group tiers of the USNVC hierarchy, we provide a summary below of the classifications based on USNVC descriptions. Each tier of the hierarchy is linked to full descriptions at the US National Vegetation Classification website (USNVC.org) down to the group level. Local, Guadalupe Mountains NP-based descriptions of individual plant associations are provided in Appendix C.

Class 1 Forest & Woodland, Subclass 1.B Temperate & Boreal Forest and Woodland, Formation 1.B.1 Temperate Flooded & Swamp Forest, Division 1.B.1.Nd Madrean-Balconian Forest & Woodland

At Guadalupe Mountains NP, the one division in the Warm Temperate Forest & Woodland Formation (1.B.1) is the Madrean-Balconian Forest & Woodland Division (1.B.1.Nd), which has two macrogroups.

Macrogroup: M010. Madrean Lowland Evergreen Woodland

Madrean Encinal occurs in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico and extends north into Trans-Pecos Texas, southern New Mexico, and sub-Mogollon Arizona. It is characterized by open-canopied to moderately closed woodlands dominated by Madrean evergreen oaks: *Quercus albocincta* (cusi oak), *Quercus arizonica* (Arizona white oak), *Quercus chihuahuensis* (Chihuahuan oak), *Quercus emoryi* (Emory oak), *Quercus grisea* (gray oak), and *Quercus oblongifolia* (Mexican blue oak). In Guadalupe Mountains NP, *Quercus grisea* is the predominant oak. Stands that are dominated or codominated by conifers such as *Juniperus deppeana* and *Pinus cembroides* (Mexican pinyon) are also part of this macrogroup and are reflected at the group level (*Pinus edulis* replaces *Pinus cembroides* at the northern end of macrogroup distribution and in the park).

Group: G201. Madrean Encinal Group

Madrean Encinal occurs in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico and extends north into Trans-Pecos Texas, southern New Mexico, and sub-Mogollon Arizona. These open-canopied to moderately closed woodlands are dominated by Madrean evergreen oaks and occur at lower elevations than the Madrean Lower Montane Pine - Oak Forest & Woodland Group (G203) and above the Madrean Pinyon - Juniper Woodland Group (G200). Lower-elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or, in some cases, desert scrub. In Guadalupe Mountains NP, the diagnostic oak is *Quercus grisea*. *Arbutus xalapensis* may be present with evergreen oaks in some stands. Madrean pines, pinyon and juniper trees may also be present but do not codominate. Chaparral shrub species such as *Cercocarpus montanus* (mountain mahogany), *Garrya wrightii* (Wright's silktassel), *Quercus* × *pauciloba* (wavyleaf oak), or *Rhus* spp. (sumac) are common in shrub understory layers but do not dominate the vegetation. An herbaceous layer is usually prominent, especially in interspaces between trees in open woodlands. Dominant species are typically warm-season perennial grasses such as *Aristida* spp.(threeawn), *Bouteloua gracilis* (blue grama), *Bouteloua curtipendula* (sideoats grama), *Digitaria pubiflora* (western witchgrass), *Eragrostis intermedia* (plains lovegrass), *Leptochloa dubia* (green sprangletop), *Muhlenbergia emersleyi* (bullgrass), or *Muhlenbergia pauciflora* (New Mexico muhly). Stands are found in Guadalupe Mountains NP from 3,937 to 7,218 ft (1,200 to 2,200 m) elevation in foothills, canyons, alluvial fan piedmonts (bajadas), and plateaus. Substrates are typically shallow, coarse-textured, lithic soils. This woodland group includes seral stands dominated by short (6.6 to 16.4 ft tall; 2 to 5 m tall) Madrean tree oaks, typically with a strong graminoid layer. In transition areas with drier chaparral, the stands of chaparral are not dominated by Madrean tree oak species; however, Madrean Encinal may extend down along drainages.

Group: G487. Madrean Juniper Open Woodland Group

This Madrean juniper savanna and woodland group occurs in northern Mexico, southeastern Arizona, and southern New Mexico and extends into western Texas. These savannas and woodlands have juniper tree canopies (5 to 60% cover). They generally lack pinyon trees and the presence of Madrean junipers such *Juniperus coahuilensis* (redberry juniper) or *Juniperus deppeana* are diagnostic of this group. In Guadalupe Mountains NP, there were four associations described that are dominated by *Juniperus deppeana* with grassy understories dominated by *Bouteloua eriopoda* (black grama), *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, *Muhlenbergia dubia* (pine muhly), *Muhlenbergia setifolia* (curlyleaf muhly), or *Piptochaetium fimbriatum* (pinyon ricegrass). If

present, the shrub layer may be open to dense with desert scrub, chaparral, or mountain shrub species such as *Agave lechuguilla*, *Ceanothus greggii* (desert ceanothus), *Cercocarpus montanus*, *Nolina microcarpa* (beargrass), *Prosopis glandulosa (*honey mesquite), *Quercus* × *pauciloba*, or *Rhus trilobata* (skunkbush sumac). Some of the widespread graminoid species, such as *Aristida purpurea (*purple threeawn), *Bouteloua gracilis*, and *Eragrostis intermedia*, are similar to those found in Great Plains Shortgrass Prairie Group (G144) and may be present to dominant. This group is found from alluvial fans and foothills to upper mountain slopes in the 5,200 to 8,200 ft (1,580 to 2,500 m) elevation range.

Group: G200. Madrean Pinyon - Juniper Woodland Group

This conifer evergreen woodland group is found in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico, and generally south of the Mogollon Rim in Arizona. Vegetation is characterized by an open tree canopy dominated by pinyon and juniper trees 6.6 to 16.4 ft (2 to 5 m) tall. In Guadalupe Mountains NP, there are five associations dominated by *Pinus edulis* with Madrean elements in the understory diagnostic of this group. *Juniperus deppeana* is often present and codominant, and *Juniperus monosperma* (oneseed juniper) may be present as well. *Pinus ponderosa* is absent or scattered. Understory layers are variable, ranging from sparse to dense grass or shrub layers. If Madrean oak trees are present, they do not dominate the tree canopy. Common shrub species may include chaparral, desert scrub, or lower montane shrubs such as *Ceanothus greggii*, *Cercocarpus montanus*, *Nolina texana* (Texas sacahuista), *Dasylirion leiophyllum* (green sotol), *Quercus* × *pauciloba*, and *Agave parryi* ssp. *neomexicana* (Parry's agave). Perennial grasses such as *Bouteloua curtipendula*, *Bouteloua gracilis*, *Muhlenbergia dubia*, *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, *Piptochaetium fimbriatum*, or *Piptochaetium pringlei* (Pringle needlegrass) are present in many stands and may form a dense herbaceous layer. Stands occur on foothills, mountains and plateaus generally between 6,050 and 8,200 ft (1,840 to 2,500 m) elevation.

Macrogroup: M011. Madrean Montane Forest & Woodland

This Madrean forest and woodland macrogroup occurs at mid to upper elevations in mountains of northern Mexico and extends into mountains of Trans-Pecos Texas, southern New Mexico, and southern Arizona. It is characterized by open- to closed-canopied conifer and mixed conifer - evergreen broad-leaved tree stands. In Guadalupe Mountains NP, there are two groups where the diagnostic species are *Pinus ponderosa*, *Pinus strobiformis* (Southwestern white pine), or *Pseudotsuga menziesii* (Douglas-fir) along with *Quercus muehlenbergii* (chinkapin oak) or *Quercus grisea* evergreen oaks.

Group: G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group

This forest and woodland group occurs in mountains and on plateaus generally at mid elevations (4,790 to 7,870 ft; 1,460 to 2,400 m) in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico, and Arizona. In Guadalupe Mountains NP, these stands are dominated by *Pinus ponderosa* with a mix of northern and Madrean species in the understory that are classified into five associations. Subcanopy tree species may include *Quercus gambelii* (Gambel's oak) along with *Juniperus deppeana* and *Pinus edulis*. Shrub layers may include encinal and chaparral species, such as *Agave* spp., *Garrya ovata* (eggleaf silktassel), N*olina texan*a, and *Quercus* × *pauciloba* at the dry end, and *Robinia neomexicana* (New Mexico locust), *Fendlera rupicola* (cliff fendlerbrush), and *Symphoricarpos oreophilus* (whortleleaf snowberry) at the moist end. Stands can have high cover of perennial graminoids such as *Muhlenbergia emersleyi*, *Festuca arizonica* (Arizona fescue), *Piptochaetium fimbriatum*, *Panicum bulbosum* (bulb panicgrass), and *Eragrostis intermedia*. Sites are variable, ranging from warm to cool, xeric to dry-mesic, gentle to very steep slopes, and dry benches that occur at lower to mid-montane elevations. In Guadalupe Mountains NP, elevations range from 5,300 to 8,350 ft (1,600 to 2,550 m) on moderate to steep slopes (25% average) Substrates are generally lithic soils derived from limestone, but include finer-textured alluvial soils along streams. Fires are frequent with perhaps more crown fires than ponderosa pine woodlands, which tend to have more frequent ground fires on gentle slopes.

Group: G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group

This forest and woodland group is found at upper elevations in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico. In the United States, it occurs in the sky islands of Arizona and from southern New Mexico to the Trans-Pecos region

of Texas. The vegetation is characterized by large- and small-patch forests and woodlands dominated by *Abies concolor* (white Fir), *Pinus strobiformis*, or *Pseudotsuga menziesii* along with the deciduous oaks *Quercus muehlenbergii* and *Quercus gambelii* (often prominent in the shrub layer). *Acer grandidentatum* can be a canopy codominant, and *Juniperus deppeana* or *Juniperus flaccida* (drooping juniper) may also be present in the subcanopy. *Pinus ponderosa* may occur as a seral species mixed into the stands. In Guadalupe Mountains NP, 17 associations dominated by either *Pseudotsuga* or *Pinus strobiformis* have been described; *Abies concolor* and *Juniperus flaccida* are absent while *Ostrya knowltonii* (Knowlton's hophornbeam) is a common subcanopy tree or shrub. Mesic shrubs can be prevalent in the understory such as *Amelanchier utahensis* (Utah serviceberry), *Holodiscus dumosus* (rockspirea), *Philadelphus microphyllus* (littleleaf mockorange), *Prunus serotina* (black cherry), *Symphoricarpos* spp. (snowberry), and *Robinia neomexicana*. Stands occur in cooler upper montane and subalpine sites in the Sierra Madres and in the southwest United States. In Guadalupe Mountains NP, it occurs on moderate to steep slopes (30% average) at elevations ranging from about 5,000 to 8,500 ft (1,500 to 2,600 m). It may also occur at lower elevations in ravines and canyons where there is significant cold-air drainage. It is similar to Southern Rocky Mountain White Fir - Douglas-fir Dry Forest Group (G226), but that group typically lacks Madrean elements.

Class 1 Forest & Woodland, Subclass 1.B Temperate & Boreal Forest and Woodland, Formation 1.B.2 Cool Temperate Forest & Woodland, Division 1.B.2.Nb Rocky Mountain Forest & Woodland

At Guadalupe Mountains NP, there are two divisions in the Cool Temperate Forest & Woodland Formation (1.B.2). The first is the Rocky Mountain Forest & Woodland Division (1.B.2.Nb), which has two macrogroups.

Macrogroup: M020. Rocky Mountain Subalpine - High Montane Forest

This is a diverse macrogroup of high montane and subalpine forests and woodlands found throughout the mountainous regions of the western United States and southwestern Canada.

Group: G222. Rocky Mountain Subalpine - Montane Aspen Forest & Woodland Group

This widespread group is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western United States, south into northern Mexico, and north into Canada. These are upland forests and woodlands dominated by *Populus tremuloides* (quaking aspen) and other cold deciduous trees. In Guadalupe Mountains NP, stands are dominated by *Acer grandidentatum* with only scattered small stands of *Populus tremuloides*. The conifer component is < 25% of the tree cover. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids and/or forbs. The most common shrub is *Quercus gambelii*. In the park, this group has an elevation range of about 5,500 to 7,700 ft (1,680 to 2,350 m) and occurs on moderate to steep slopes (30% average) mostly in ravines and canyons where there is significant cold-air drainage.

Macrogroup: M022. Southern Rocky Mountain Lower Montane Forest

These are conifer and mixed deciduous-conifer lower montane forests, woodlands, and savannas of the southern Rocky Mountains and the ranges of the Great Basin.

Group: G229. Southern Rocky Mountain Ponderosa Pine Open Woodland Group

This group is found predominantly in the Colorado Plateau region, west into scattered locations in the Great Basin, north along the eastern front of the southern Rocky Mountains, and also in southern New Mexico and the Trans-Pecos of Texas. These open woodlands occur in warm, dry, exposed sites in contrast to the more mesic sites of G222. In Guadalupe Mountains NP, this group is found at the highest elevations of ridge summits at around 7,950 ft (4,425 m). The group is represented by one association dominated by *Pinus ponderosa* and is best described as a savanna with widely spaced trees (< 25% tree canopy cover). Historically, it was likely maintained by a fire regime of frequent, low-intensity surface fires. The understory is grassy and dominated by the cool-season *Festuca arizonica*. The shrub *Quercus gambelii* may be common but not dominant.

Class 1 Forest & Woodland, Subclass 1.B Temperate & Boreal Forest and Woodland, Formation 1.B.2 Cool Temperate Forest & Woodland, Division 1.B.2.Nc Western North American Pinyon - Juniper Woodland & Scrub

The second division in the Cool Temperate Forest & Woodland Formation (1.B.2) at Guadalupe Mountains NP is the Western North American Pinyon - Juniper Woodland & Scrub Division (1.B.2Nc), which has one macrogroup.

Macrogroup: M027. Southern Rocky Mountain - Colorado Plateau Two-needle Pinyon - Juniper Woodland

This southern Rocky Mountain and Colorado Plateau pinyon and juniper savanna and woodland macrogroup is characterized by an open to closed evergreen, conifer tree canopy composed of diagnostic species *Juniperus monosperma* and/or *Pinus edulis* with an understory dominated by shrubs or grasses that lacks Madrean understory species. It occurs in dry mountains and foothills in southern Colorado south into northern and central New Mexico and extends west across the Colorado Plateau and east to the southwestern Great Plains. It also occurs in the foothills and mesas of the southern New Mexico and the Trans-Pecos of Texas.

Group: G253. Southern Rocky Mountain Pinyon - Juniper Woodland Group

This southern Rocky Mountain woodland group occurs on dry mountains and foothills in southern Colorado east of the Continental Divide and in mountains and plateaus of New Mexico (and Trans-Pecos Texas). It also extends east to the southeastern Great Plains. In Guadalupe Mountains NP, this group is a minor element of the vegetation matrix of pinyon-juniper woodlands dominated by the Madrean Pinyon - Juniper Woodland Group (G200). The vegetation is represented by one association dominated by *Pinus edulis* or codominated by *Pinus edulis* and *Juniperus monosperma* in the tree canopy. Stands are grassy and dominated by B*outeloua gracilis* and *Achnatherum lobatum* (little awn needlegrass) and are found at moderate elevations (e.g., 6,500 ft; 2,000 m).

Class 1 Forest & Woodland, Subclass 1.B Temperate & Boreal Forest and Woodland, Formation 1.B.3 Temperate Flooded & Swamp Forest, Division 1.B.3.Nd Western North American Interior Flooded Forest

At Guadalupe Mountains NP, the one division in the Temperate Flooded & Swamp Forest Formation (1.B.3) is the Western North American Interior Flooded Forest Division (1.B.3.Nd), which has one macrogroup.

Macrogroup: M036. Interior Warm & Cool Desert Riparian Forest

This macrogroup covers warm- and cold-climate riparian and wetland forested vegetation of the southwestern deserts and western interior United States, including the Tamaulipan area of southern Texas. This is a diverse macrogroup made up of a mix of phreatophyte trees and shrubs (e.g. *Populus* spp., *Juglans* spp. [walnut] and *Salix* spp. [willow], etc.). In Guadalupe Mountains NP, it is represented by one group.

Group: G797. Western Interior Riparian Forest & Woodland

In Guadalupe Mountains NP, this riparian forested wetland is dominated by *Populus deltoides* ssp. *wislizeni* (Rio Grande cottonwood) with a diverse shrub layer dominated by *Baccharis salicina* (false willow) along with desert wash species such as *Fallugia paradoxa* (Apacheplume) and *Brickellia laciniata* (splitleaf brickellbush). The herbaceous layer can include facultative and obligate wetland species, such as *Juncus torreyi* (Torrey's rush), *Muhlenbergia asperifolia* (alkali muhly), *Adiantum capillus-veneris* (common maidenhair), *Lobelia cardinalis* (cardinalflower), *Samolus ebracteatus* ssp. *cuneatus* (limewater brookweed), and *Typha domingensis* (southern cattail); these species are typically found along the margins of stands along the borders of stream channels. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Periodic flooding and associated sediment scour are necessary to maintain growth and reproduction of vegetation.

Class 2 Shrub & Herb Vegetation, Subclass 2.B Temperate & Boreal Grassland & Shrubland, Formation 2.B.2 Temperate Grassland & Shrubland, Division 2.B.2.Nf Western North American Grassland & Shrubland

At Guadalupe Mountains NP, three divisions are present in the Temperate Grassland & Shrubland Formation (2.B.2). The first division is the Western North American Grassland & Shrubland Division (2.B.2.Nf), which has two macrogroups.

Macrogroup: M168. Rocky Mountain - Vancouverian Subalpine - High Montane Mesic Meadow

This macrogroup includes montane and subalpine mesic meadows from the Rocky Mountains west to the Sierra Nevada and eastern Cascades and drier grasslands from the southern Rocky Mountains west in high plateaus and ranges. Vegetation is composed of low (< 3.3 ft; < 1 m), open to dense perennial graminoid layers. In montane and subalpine grasslands in the southern Rocky Mountains, characteristic species are usually cool-season (C3) grasses (e.g., *Festuca arizonica* in Guadalupe Mountains NP).

Group: G268. Southern Rocky Mountain Montane - Subalpine Grassland Group

This southern Rocky Mountains group extends west to high plateaus and mountains in the Colorado Plateau and south through higher mountains of southern Arizona, New Mexico, and west Texas. Vegetation is characterized by an open to dense perennial graminoid layer. In Guadalupe Mountains NP, the two associations are dominated by *Festuca arizonica* and *Achnatherum lobatum*, respectively, and *Bouteloua gracilis*, *Bouteloua curtipendula*, and *Andropogon gerardii* (big bluestem) are occasional associates. Among forbs, meadow species such as *Chenopodium graveolens* (fetid goosefoot), *Verbena macdougalii* (MacDougal verbena), *Eriogonum hieraciifolium* (hawkweed buckwheat), and *Giliastrum acerosum* (bluebowls) may be present. Elsewhere in the southern Rocky Mountains, these large-patch grasslands are intermixed among forests and woodlands, but in Guadalupe Mountains NP they are found only as smaller patches at the highest elevations (6,000 to 7,700 ft; 2,360 to 2,360 m).

Macrogroup: M049. Southern Rocky Mountain Montane Shrubland

This shrubland macrogroup is found in the foothills, canyon slopes, and montane zone of mountains of the southern Rocky Mountains and Colorado Plateau and extends onto outcrops and canyon slopes in the western and southern Great Plains. It also occurs in the island mountain ranges of the southwestern United States. The vegetation is characterized by an open to dense shrub layer typically dominated by *Cercocarpus montanus*, *Purshia tridentata* (antelope bitterbrush), and/or *Quercus gambelii*, and several other characteristic montane chaparral species. There are two groups in this macrogroup.

Group: G276. Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group

This Rocky Mountain foothill shrubland group ranges from southern New Mexico and west Texas north into Wyoming and west into the Intermountain West. The vegetation is typically dominated by montane chaparral shrubs, and in Guadalupe Mountains NP there is one association dominated by *Cercocarpus montanus* and *Quercus* × *pauciloba* with *Rhus trilobata*, *Ceanothus greggii*, and *Rosa stellata* as common associates. Grasses and sedges are dominant in the understory, and in the Guadalupe Mountains they are dominated by *Muhlenbergia dubia* and *Muhlenbergia pauciflora*. Scattered trees, inclusions of grassland patches, or steppe may be present. Stands are found in the foothills, mountain canyon slopes, and outcrops. In Guadalupe Mountains NP, these shrublands occur between 6,500 and 8,000 ft (1,980 to 2,440 m) elevation. This group is generally drier than Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland (G277) and, in the park, is closely related to Western Madrean Chaparral (G281) and Eastern Madrean Chaparral (G280). Fire plays an important role in this group; *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root-crown sprouting. Stands often develop following crown fires of forest and woodlands, and successional return to forest may be slow or effectively nonexistent as sites dry out and shrubs dominate sites and exclude conifer reproduction.

Group: G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group

This group occurs in the mountains, plateaus, and foothills of the southern Rocky Mountains and Colorado Plateau and extends southward into Southern Arizona, New Mexico, and West Texas. In Guadalupe Mountains NP, the vegetation is represented by three associations dominated by *Quercus gambelii* with *Robinia neomexicana* as a possible codominant. The understories tend to be grassy and dominated by *Piptochaetium fimbriatum*, *Festuca arizonica*, or *Carex inops* (long-stolon sedge) in the park. These shrublands are most commonly found on cool mountain slopes and summits of Guadalupe Mountains NP from approximately 7,100 to 8,200 ft (2,160 to 2,500 m) elevation. They commonly develop following fires in the Madrean Montane Forest & Woodland (M011) and can form extensive patches in the forest matrix. This group also intergrades with the Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group (G276) on drier sites.

Class 2 Shrub & Herb Vegetation, Subclass 2.B Temperate & Boreal Grassland & Shrubland, Formation 2.B.2 Temperate Grassland & Shrubland, Division 2.B.2.Nb Central North American Grassland & Shrubland

The second division in the Temperate Grassland & Shrubland Formation (2.B.2) is the Central North American Grassland & Shrubland Division (2.B.2.Nb), which has one macrogroup.

Macrogroup: M053. Western Great Plains Shortgrass Prairie

This macrogroup is composed of the matrix of short grasslands in the western Great Plains, from southeastern Wyoming to the Texas panhandle, with disjunct occurrences extending westward to Arizona and southward into the Trans-Pecos of Texas. It is characterized by the dominance of short grasses *Bouteloua gracilis* and *Buchloe dactyloides* (buffalograss).

Group: G144. Great Plains Shortgrass Prairie Group

This group is most prevalent in the western half of the Great Plains but extends into the southwestern United States and Trans-Pecos region of Texas. *Bouteloua gracilis* is the typical dominant species. Associated graminoids may include *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua hirsuta* (hairy grama), *Buchloe dactyloides*, *Hesperostipa comata* (needle-and-thread grass), *Hesperostipa neomexicana* (New Mexico needlegrass), *Koeleria macrantha* (= *Koeleria cristata*; prairie junegrass), *Pascopyrum smithii* (= *Agropyron smithii*; western wheatgrass), *Pleuraphis jamesii* (James' galleta), and *Sporobolus cryptandrus* (sand dropseed). In Guadalupe Mountains NP, there are two associations dominated by *Bouteloua gracilis* with *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Setaria leucopila* (streambed bristlegrass), *Aristida purpurea*, and *Sporobolus cryptandrus* as common associates. Scattered shrub and dwarf-shrub species occur, and in the park these include *Yucca elata* (soaptree yucca), *Mimosa aculeaticarpa* var. *biuncifera* (catclaw mimosa), *Nolina texana*, and *Gutierrezia sarothrae* (broom snakeweed) along with succulents such as *Opuntia phaeacantha* (tulip pricklypear), *Opuntia engelmannii* (cactus apple), and *Cylindropuntia imbricata* (tree cholla). This group occurs primarily on flat to rolling uplands and foothills and is occasionally is in mountain valleys. Based on plot data, elevations range from 5,500 to 5,700 ft (1,675 to 1,740 m).

Large-scale processes such as climate, fire, and grazing influence this group. High variation in amount and timing of annual precipitation impacts the relative cover of cool- and warm-season herbaceous species. In contrast to other prairie groups, fire is less important, especially in the western range of this group. This is because the dry to xeric climate conditions produce less vegetation/fuel load, so relative fire frequency is lower. However, historically, fires that did occur were often very expansive, especially after a series of years with above-average precipitation when litter/fine fuels could build up. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this group (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this group are extremely drought and grazing tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This group, in combination with the associated wetland groups, represents one of the richest areas for mammals and birds. Bird species endemic to the shortgrass group may constitute one of the fastest declining bird populations.

Class 2 Shrub & Herb Vegetation, Subclass 2.B Temperate & Boreal Grassland & Shrubland, Formation 2.B.2 Temperate Grassland & Shrubland, Division 2.B.2.Nd Western North American Interior Chaparral

The third division in the Temperate Grassland & Shrubland Formation (2.B.2) is the Western North American Interior Chaparral Division (2.B.2.Nd), which has one macrogroup.

Macrogroup: M091. Warm Interior Chaparral

This interior chaparral macrogroup occurs across central Arizona (Mogollon Rim) and southern New Mexico, east in the mountains across Trans-Pecos Texas, and into the Madrean Occidentale and Madrean Oriental in northern Mexico. Occurrences are also found in mountains in the Sonoran and Mojave Deserts. The vegetation is characterized by a moderate to dense evergreen shrub layer less than 9.8 ft (3 m) tall which is dominated by scrub oak and sclerophyllous shrubs. In Guadalupe Mountains NP, two groups in this macrogroup are present.

Group: G281. Western Madrean Chaparral Group

This interior chaparral group is dominated by an often diverse and moderate to dense evergreen shrub layer of sclerophyllous shrubs, which, in Guadalupe Mountains NP, include one association dominated by *Cercocarpus montanus* var. *paucidentatus (*shaggy mountain mahogany), with *Ceanothus greggii*, *Garrya ovata* ssp. *goldmanii (*Goldman's silktassel), *Quercus* × *pauciloba*, *Quercus pungens* (pungent oak), and *Rhus trilobata* as common associates. Understories can be sparse to grassy, and in Guadalupe Mountains NP, *Muhlenbergia pauciflora* is the common dominant. Scattered remnant pinyon and juniper trees may be present. Stands are found from the foothills to upper mountain slopes (5,000 to 8,300 ft; 1,000 to 2,200 m). Sites are often steep, rocky, and drier than adjacent landscape slopes. Occasional desert scrub species may be present in drier, rockier, more open transition sites. Most chaparral species are fire-adapted, sprouting vigorously after burning or producing abundant fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. The similar Eastern Madrean Chaparral Group (G280) has floristics mostly derived from the eastern Sierra Madre Oriental, particularly with respect to the oak element.

Group: G280. Eastern Madrean Chaparral Group

This chaparral group is found in mid-elevation sites in the Madrean Oriental in northern Mexico and desert mountains across Trans-Pecos Texas extending to the Guadalupe Mountains. It is characterized by a moderate to dense shrub canopy dominated by evergreen shrub oak species, which, in Guadalupe Mountains NP, include seven associations dominated by *Quercus pungens*, *Quercus grisea*, or *Quercus* × *pauciloba* and several chaparral species such as *Ceanothus greggii*, *Cercocarpus montanus*, and *Garrya ovata*. Some stands are dominated by shrub to short tree forms of *Juniperus pinchotii*. Stands occur on foothills, mountain slopes, and canyons in drier habitats below, often intermixed with pinyon-juniper woodlands. Elevations range from 5,000 to 8,250 ft (1,525 to 2,500 m). Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Achnatherum lobatum*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Muhlenbergia dubia*, *Muhlenbergia setifolia,* and *Muhlenbergia emersleyi*. This group is different from the mattoral (thornscrub) of Mexico in that it is typically dominated by shrubby evergreen oaks and chaparral species, not thornscrub species.

Class 2 Shrub & Herb Vegetation, Subclass 2.C Shrub & Herb Wetland, Formation 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland, Division

At Guadalupe Mountains NP, the one division in the Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation (2.C.4) is the Western North American Temperate Freshwater Marsh, Wet Meadow & Shrubland Division (2.C.4.Nb), which has one macrogroup.

Macrogroup: M888. Arid West Interior Freshwater Marsh

These arid west freshwater marshes are found at all elevations below alpine throughout the interior basins and mountains of western North America, with dominant species such *Carex pellita* (woolly sedge), *Carex praegracilis* (clustered field sedge), *Eleocharis palustris* (common spikerush), *Juncus balticus* (mountain rush), *Paspalum distichum* (knotgrass), *Schoenoplectus americanus* (American bulrush),

Schoenoplectus pungens (common threesquare), *Typha domingensis* (southern cattail), *Typha latifolia* (broadleaf cattail), *Bidens* spp. (beggarticks), *Cicuta* spp. (water hemlock), *Cyperus* spp. (sedges), *Mimulus* spp. (monkeyflower), and *Phalaris* spp. (canarygrass).

Group: G531. Arid West Interior Freshwater Marsh Group

In Guadalupe Mountains NP, this wetland group is found scattered along McKittrick Creek and is dominated by *Schoenoplectus americanus*, *Panicum virgatum* (switchgrass), and *Eleocharis rostellata* (beaked spikerush). The extent of this type in the McKittrick Creek floodplain varies with the time elapsed since the last significant flood event. Floods tend to remove vegetation and surfaces or bury them, so that up to a decade is needed before well-developed marsh vegetation again dominates.

Class 2 Shrub & Herb Vegetation, Subclass 2.C Shrub & Herb Wetland, Formation 2.C.5 Salt Marsh, Division 2.C.5.Nd North American Western Interior Brackish Marsh, Playa & Shrubland

At Guadalupe Mountains NP, the one division in the Salt Marsh Formation (2.C.5) is the North American Western Interior Brackish Marsh, Playa & Shrubland Division(2.C.5.Nd), which has one macrogroup.

Macrogroup: M082. Warm & Cool Desert Alkali - Saline Marsh, Playa & Shrubland

This macrogroup consists of alkaline and saline wetlands with salt-tolerant plant growth where dominant and characteristic plant species include *Atriplex* spp. (saltbush), *Distichlis spicata* (saltgrass), *Salicornia* spp. (pickleweed), *Sarcobatus vermiculatus*, *Sesuvium verrucosum* (greasewood), *Sporobolus* spp., *Suaeda moquinii* (Mojave seablite), and *Triglochin maritima* (seaside arrowgrass). These are located in playas, washes, mudflats, and depressional wetlands where evaporation far exceeds precipitation and/or where bedrock and soil properties contribute to alkaline/saline conditions. Sites are found throughout the western United States and southwestern Canada.

Group: G538. North American Desert Alkaline - Saline Marsh & Playa Group

This group is found in the intermountain western United States. Composition of these associations varies and can range from densely vegetated seasonal wetlands and saltwater emergent marshes to barren or sparsely vegetated playas (generally <10% plant cover). In Guadalupe Mountains NP, it is typified by west-side basin bottom grasslands dominated by *Sporobolus airoides* (alkali sacaton) with scattered shrubs such as *Suaeda moquinii* and *Atriplex canescens* (fourwing saltbush).

Class: 3 Desert & Semi-Desert, Subclass 3.A Warm Desert & Semi-Desert Woodland, Scrub & Grassland, Formation 3.A.2 Warm Desert & Semi-Desert Scrub & Grassland, Division 3.A.2.Na Warm Desert Scrub & Grassland

At Guadalupe Mountains NP, the one division in the Warm Desert & Semi-Desert Scrub & Grassland (3.A.2) is the North American Warm Desert Scrub & Grassland Division(3.A.2.Na), which has four macrogroups.

Macrogroup: M086. Chihuahuan Desert Scrub

This widespread Chihuahuan Desert scrub macrogroup has a moderate to sparse xeromorphic shrub layer frequently dominated by these diagnostic species: *Acacia constricta* (whitethorn acacia), *Vachellia neovernicosa*, *Flourensia cernua*, *Larrea tridentata*, *Prosopis glandulosa*, or *Prosopis velutina* (velvet mesquite). Stands may be dominated by a single species or be mixed, with stands having overall composition of a variety of desert scrub, thornscrub, stem rosette, and succulent species.

Group: G288. Chihuahuan Creosotebush - Mixed Desert Scrub Group

This group is the extensive desert scrub that occurs in the broad desert basins and plains extending up onto dissected gravelly alluvial fans, piedmonts (bajadas), and foothills in the Chihuahuan Desert below the chaparral zone. The vegetation has a moderate to sparse shrub layer (< 10% cover on extremely xeric sites). *Larrea tridentata* is the most common dominant, often covering entire landscapes in near monotypic stands and represented by the 11 associations in Guadalupe Mountains NP. Stands can also be codominated or dominated by a mix of thornscrub or other desert scrub species, which, in Guadalupe Mountains NP, include *Vachellia neovernicosa* or *Acacia constricta*, *Flourensia cernua*, *Mimosa aculeaticarpa* var. *biuncifera*, *Mortonia scabrella* (= *Mortonia sempervirens* ssp. *scabrella*; Rio Grande saddlebush), *Parthenium incanum* (mariola), *Viguiera stenoloba*, and *Yucca* spp. Stands of thornscrub dominated by *Acacia constricta* or *Vachellia neovernicosa* are included in this group. *Prosopis glandulosa* may

be present but does not dominate the shrub layer. Grasses are common but generally have lower cover than shrubs. Common species may include *Bouteloua eriopoda*, *Dasyochloa pulchella* (fluffgrass), and *Muhlenbergia porteri* (bush muhly). Some shrublands have a sparse understory, sometimes with a pebbly desert pavement on the soil surface. Depending on soil conditions and landscape position, these shrublands may represent an expansion into former desert grasslands.

Group: G299. Chihuahuan Desert Lowland Basin Scrub Group

This desert scrub group occurs extensively as open-canopied shrublands in the alkaline, often somewhat saline, basins and lowlands in the Chihuahuan Desert. It commonly includes stands dominated by *Atriplex canescens* or *Flourensia cernua*, but under more saline conditions *Allenrolfea occidentalis* (iodinebush), *Sarcocornia utahensis* (Utah swampfire), *Suaeda moquinii*, or other halophytic plants may be present to codominant. In Guadalupe Mountains NP, the group is represented by two associations dominated by either *Larrea tridentata* or *Prosopis glandulosa* along with scattered *Atriplex canescens*. While sites are often barren in the inter-shrub spaces, others can have high graminoid cover dominated by *Sporobolus airoides*. Stands often occur on alluvial flats and around playas, as well as in floodplains.

Group: G287. Chihuahuan Desert Sand Scrub Group

This group includes the open desert scrub of vegetated coppice dunes and sandy plains found in the Chihuahuan Desert. In Guadalupe Mountains NP, stands are represented by four plant associations dominated by the tall shrubs *Psorothamnus scoparius* (broom dalea), *Atriplex canescens*, *Poliomintha incana* (frosted mint), or *Larrea tridentata* that anchor coppice dunes or occur on open sandsheet flats. *Ephedra torreyana* (Torrey's jointfir), *Ephedra trifurca* (longleaf jointfir), and *Yucca elata* are common associates and the inter-shrub spaces can be sparse or grassy and dominated by sand dropseeds such as *Sporobolus flexuosus* (mesa dropseed), *Sporobolus contractus* (spike dropseed), *Sporobolus cryptandrus*, or *Sporobolus giganteus* (giant dropseed).

Group: G286. Chihuahuan Desert Succulent Scrub Group

This rocky-site Chihuahuan Desert scrub group is characterized by the relatively high cover and rich flora of succulents and other desert scrub species. In Guadalupe Mountains NP, the group is represented by three associations dominated by *Vachellia neovernicosa* or *Fouquieria splendens* (ocotillo) with understories that are dominated by subshrubs and succulents such as *Agave lechuguilla*, *Echinocereus* spp. (hedgehog cactus), *Escobaria* spp. (foxtail cactus), *Opuntia macrocentra* (purple pricklypear), *Opuntia phaeacantha*, *Thymophylla acerosa* (pricklyleaf dogweed), *Tiquilia* spp. (crinklemat), *Yucca torreyi* (Torrey's yucca), and many others. Perennial grass cover is generally low. The abundance of succulents is diagnostic of this desert scrub group, but desert shrubs and subshrubs are usually present but not codominant, except for the near ubiquitous desert shrubs *Larrea tridentata* and *Parthenium incanum*. It is found in the Chihuahuan Desert on alluvial fans and fan piedmonts (bajadas), colluvial foothill slopes and ridges, and mesas. Sites are hot and dry, typically with southerly aspects. Gravel and rock are often abundant on the ground surface and the highest cover often occurs on limestone. Stands in rolling topography may form a mosaic with more mesic desert scrub or desert grassland groups. *Agave lechuguilla* is more abundant in stands in the southern part of the range. This group does not include desert grasslands or shrub-steppe with a significant cacti component such as yucca or cholla grassland with a high grass cover.

Group: G847. Chihuahuan Gypsophilous Scrub Group

This group is restricted to gypsum outcrops, gypsiferous soils and gypsum dunes in the Chihuahuan Desert. Vegetation is composed of typically sparse to open shrublands that are characterized by a variety of gypsophilous plants in the understory, which are endemic to these habitats. In Guadalupe Mountains NP, there are six plant associations in this group dominated by either *Atriplex canescens* or *Poliomintha incana* with understories that can be grassy and include *Sporobolus nealleyi* (gyp dropseed), *Bouteloua breviseta* (gypsum grama), and *Andropogon hallii* (sand bluestem) and a mix of sub-shrubs and forbs such as *Mentzelia humilis* (gypsum blazingstar), *Nama carnosum* (sand fiddleleaf), *Sartwellia flaveriae* (threadleaf glowwort), *Selinocarpus lanceolatus* (lanceleaf moonpod), and other gypsophilous species.

Macrogroup: M087. Chihuahuan Semi-Desert Grassland

This warm-temperate to subtropical, semi-desert scrub macrogroup occurs in the southwestern United States, the adjacent Sonoran Desert in Mexico, and the central to northern parts of Baja California, Mexico, and is characterized by a sparse to moderately dense layer (1 to 50% cover) of xeromorphic, evergreen and drought-deciduous, microphyllous and broad-leaved shrubs and/or succulent species, especially cacti and rosette stem succulents and sarcocaulescent trees and shrubs. *Larrea tridentata* is often present to dominant with *Ambrosia dumosa* (burrobush) and many Sonoran or Mojave Desert diagnostic species.

Group: G490. Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland

This group is a widespread and diverse desert grassland (shrub-steppe) that stretches across much of the Chihuahuan Desert west to the Sonoran Desert and north across the USA-Mexico border into southern Arizona and New Mexico. The vegetation is characterized by an open to dense herbaceous layer dominated by a diverse mixture of perennial desert grasses. Scattered shrubs and succulents are typically present, but usually have lower total cover than the herbaceous layer. In Guadalupe Mountains NP, it is represented by 28 associations dominated by grasses such as *Bouteloua eriopoda*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Muhlenbergia setifolia*, *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, *Hesperostipa neomexicana*, *Nassella tenuissima* (Finestem needlegrass), and *Eragrostis intermedia*. Also typical are succulents such as *Agave lechuguilla*; rosetophyllous shrubs such as species of *Nolina*, *Dasylirion*, and *Yucca*; and short (dwarf) shrubs including *Dalea formosa* (featherplume), *Parthenium incanum*, and *Gutierrezia sarothrae*. Scattered tall shrubs and short trees such as *Viguiera stenoloba*, *Fouquieria splendens*, *Aloysia wrightii* (Wright's beebrush), *Mimosa aculeaticarpa* var. *biuncifera*, and *Juniperus pinchotii* can be prevalent in what are essentially shrub-steppe communities, but shrub cover seldom exceeds 10% and good grass cover remains diagnostic. Stands occur on gently sloping alluvial erosional fans and piedmonts (bajadas) at lower elevations (3,770 ft; 1,150 m), and they extend onto foothill slopes up to 6,750 ft (2,057 m).

Many of the historical desert grassland and savanna areas have been converted through intensive grazing and other land uses, some to North American Warm Desert Ruderal Scrub Group (G819; *Prosopis* spp.-dominated) or Chihuahuan Creosotebush - Mixed Desert Scrub Group (G288; *Larrea tridentata*-dominated).

Group: G492. Chihuahuan Gypsophilous Grassland Group

This group is restricted to gypsum outcrops, gypsiferous soils, and gypsum dunes, and in Guadalupe Mountains NP, is represented by six plant associations dominated by *Bouteloua breviseta*, *Sporobolus nealleyi*, or *Sporobolus airoides* in combination with shrub and forb gypsophiles such *Tiquilia hispidissima* (hairy crinklemat), *Sartwellia flaveriae,* and *Mentzelia humilis* var. *guadalupensis* plus other shrub species such as *Ephedra torreyana* and *Yucca elata*. In Guadalupe Mountains NP, stands occur at low elevations around 3,650 ft (1,110 m) .

Group: G491. Chihuahuan Sandy Plains Semi-Desert Grassland Group

This dry grassland group occurs on sandy sites across the Chihuahuan Desert with the graminoid layer typically dominated or codominated by *Bouteloua eriopoda* and *Sporobolus flexuosus*. In Guadalupe Mountains NP, *Bouteloua gracilis* can be a codominant. Other common species are *Aristida purpurea*, *Muhlenbergia arenicola* (sand muhly), and *Sporobolus cryptandrus*. Typically, there are scattered desert shrubs and stem succulents present, such as *Ephedra torreyana*, *Opuntia phaeacantha*, and *Yucca elata*. In Guadalupe Mountains NP, stands occur on sandy plains and on sand-covered alluvial fans and foothills at elevations between 4,400 and 6,000 ft (1,340 to 1,825 m).

Group: G489. Chihuahuan Semi-Desert Lowland Grassland Group

This is the common lowland grassland group that occurs in the northern Chihuahuan Desert, adjacent southwestern Great Plains, and Arizona sky islands west to the Sonoran Desert. Vegetation in this group is characterized by a moderately dense to dense graminoid layer of perennial grasses that is typically dominated by *Pleuraphis mutica* (tobosagrass) and/or *Sporobolus airoides* with *Panicum obtusum* (vine mesquite) often present. In Guadalupe Mountains NP, it is represented by one plant association dominated by *Bouteloua gracilis*, *Bouteloua curtipendula*, and *Panicum obtusum* that occur on benches adjacent to drainages between 6,000 and 6,500 ft (1,825 to 1,980 m).

Scattered shrub or succulent species may be present, such as *Fallugia paradoxa* and *Mahonia haematocarpa* (red barberry).

Macrogroup: M092. North American Warm-Desert Xeric - Riparian Scrub

This macrogroup represents shrublands along ephemeral washes and intermittent streams dominated by shrubs that can tolerate episodic, often extremely high stream flows, such *Chilopsis linearis* (desert willow), *Fallugia paradoxa*, and *Hymenoclea monogyra* (singlewhorl burrobrush).

Group: G541. Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group

This group is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains, and basin floors throughout the warm deserts of the western United States and northwestern Mexico. A woody layer is usually present and is typically in scattered clumps to very open and may be dominated by shrubs and small trees. In Guadalupe Mountains NP, there are seven associations dominated by *Chilopsis linearis*, *Fallugia paradoxa*, *Brickellia laciniata*, *Prosopis glandulosa*, and *Juglans microcarpa* (little walnut). When *Prosopis glandulosa* occurs in or along ephemeral washes, it is not considered necessarily invasive. Although often dry, the intermittent fluvial processes are characteristic of this group, which is often associated with rapid sheet and gully flow. This group is restricted to drainages in upland areas that are intermittently flooded and occur as linear or sometimes broader braided strips within desert scrub-dominated or desert grassland-dominated landscapes. The vegetation of desert washes is quite variable in species composition and structure, ranging from sparse and patchy to moderately dense, and typically occurs along the banks, but may occur within the channel. In Guadalupe Mountains NP, *Bouteloua curtipendula*, *Setaria leucopila*, *Bothriochloa laguroides* (silver beardgrass), and *Eragrostis intermedia* are common associates.

Macrogroup: M512. North American Warm Desert Ruderal Scrub & Grassland

This upland warm desert thornscrub and grassland macrogroup contains disturbed semi-arid grasslands and desert thornscrub that are dominated by non-native species and are found in the southwestern United States and northern Mexico.

Group: G819. North American Warm Desert Ruderal Scrub Group

This broadly defined ruderal scrub group occurs in Arizona, New Mexico, western Texas, northern Mexico, and elsewhere in the Desert Southwest. It primarily includes upland desert scrub dominated by *Prosopis glandulosa* and *Prosopis velutina*, which are native but invasive species that have invaded former grasslands. In Guadalupe Mountains NP, *Prosopis glandulosa* forms coppice dune areas of low diversity with only scattered grasses and forbs such as *Sporobolus flexuosus* and *Dasyochloa pulchella* in the interdune spaces.

Class: 3 Desert & Semi-Desert, Subclass: 3.B Cool Semi-Desert Scrub & Grassland, Formation 3.B.1 Cool Semi-Desert Scrub & Grassland, Division 3.B.1.Ne Western North American Cool Semi-Desert Scrub & Grassland

At Guadalupe Mountains NP, the one division in the Cool Semi-Desert Scrub & Grassland (3.B.1) is the Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne), which has one macrogroup.

Macrogroup: M093. Great Basin Saltbush Scrub

This widespread cool semi-desert macrogroup centers in the Intermountain West of the United States and is typically composed of saltbush shrublands (*Atriplex* spp.).

G300. Intermountain Shadscale - Saltbush Scrub Group

This group includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the intermountain western United States and western Great Plains extending down into the Chihuahuan and Sonoran Deserts. In Guadalupe Mountains NP, the group is represented by one association that is characterized by moderately dense shrubland dominated by *Atriplex canescens* with a sparse to moderately dense grassy herbaceous layer dominated by *Sporobolus airoides* and *Scleropogon brevifolius* (burrograss).

Classification Discussion

Daubenmire (1974) suggested that plant communities integrate all impinging environmental conditions; hence, the classification and description of vegetation types as per the USNVC provides a framework for understanding the ecological conditions and

structure of a given landscape. Accordingly, USNVC plant associations or groups are used in the mapping process to define map unit components, providing the information linkage between a vegetation community's spatial distribution and its ecology. The outcome is that by grouping land areas based on the ability to support similar associations and groups, general management observations and recommendations can be made for each grouping. In addition, resource managers have found that the classification of vegetation into these units has provided insight and the ability to predict vegetation changes in response to various disturbance processes.

The development of a vegetation classification is an incremental process of successive approximation (Shimwell 1971), and we suggest that the classification presented here represents a significant refinement of the types described by Gehlbach (1967) and Bunting (1978) as well as being more comprehensive. It might be possible to analytically correlate previous vegetation studies to the classification provided here, but that is beyond the scope of this project. There are direct correlations with some of the vegetation classification and map units developed for Carlsbad Caverns NP vegetation map (Muldavin et al. 2003), but differing geology and limited elevation gradient at Carlsbad Caverns NP constrain the shared vegetation diversity (e.g., Carlsbad Caverns NP lacks extensive woodlands). The parks do have similar chaparral shrublands and desert grasslands along their southern flanks, suggesting opportunities for collaborative management in these systems.

Further work is needed to reconcile differences in vegetation units regionally across the CHDN parks and neighboring landscapes that may have a bearing on the Guadalupe Mountains NP classification (e.g., other gypsophilous communities in New Mexico and west Texas). In addition, the majority of the plant associations described here are provisional, pending acceptance into the national classification, and, as such, this classification as a whole remains provisional and subject to change pending review by appropriate entities. To address this, we suggest a network-wide analysis in a national context to determine if the provisional types proposed here should be accepted into the national classification.

Chapter 3: Guadalupe Mountains National Park Vegetation Map

Mapping Process Overview

The Guadalupe Mountains NP vegetation map was developed using a combined strategy of automated digital image classification and direct analog image interpretation of aerial photography and satellite imagery. Initially, the aerial photography and satellite imagery were processed and entered into a GIS along with ancillary spatial layers. A working map legend of ecologically-based vegetation map units was developed using the vegetation classification described in Chapter 2 as the foundation. Our intent was to develop map units that targeted the plant-association level wherever possible within the constraints of image quality, information content, and resolution. With the provisional legend and ground-control points provided by the field-plot data (the same data used to develop the vegetation classification), we used a combination of heads-up screen digitizing of polygons based on image interpretation and supervised image classifications to develop the map. The outcome was a vegetation map composed of a suite of map units defined by plant association and represented by sets of mapped polygons with similar spectral and site characteristics.

The key mapping standards of the National Vegetation Mapping Program (https://www.nps.gov/im/vegetation-inventory.htm) call for spatial data to be provided with a horizontal positional accuracy meeting National Map Accuracy Standards at the 1:24,000 scale (i.e., each well-defined object in the spatial database must be within 40 ft (12.2 m) of its actual location). In addition, each vegetation map class (unit) should meet or exceed 80% accuracy at the 90%-confidence level, and the minimum mapping unit (MMU) should be 1.24 acres (0.5 ha; see Lea 2011). Details of the accuracy assessment for the Guadalupe Mountains NP vegetation map are provided in Chapter 4.

Mapping Methods

Map development was conducted in two phases. In the first phase, an automated object-based classification was used to develop a draft polygon vegetation map with polygons provisionally classified using a raster-based supervised classification based on the 540 vegetation plots. In the second phase, the draft map was revised using analog interpretation of the most recent aerial imagery available. For the map, a hierarchical legend was developed to reflect spatial patterning and ecological relatedness of vegetation at different scales based on USNVC groups and collections of plant associations.

Data Sources and Processing

Initially, we used 2004 and 2008 National Agriculture Imagery Program (NAIP) four-band aerial imagery available as Digital Orthophoto Quarter Quads (DOQQs) from the Texas Natural Resources Information System (https://tnris.org/). This imagery came in natural color and color-infrared sets that all together gathered four separate bands of spectral reflectance values from the visible blue to the near-infrared (NIR) wavelengths at a 1-m (3.3-ft) spatial resolution. A Normalized Difference Vegetation Index (NDVI) was computed on the mosaic and used as a layer to enhance the vegetative component of the landscape. A NDVI emphasizes vigorous green plant growth by comparing a strong chlorophyll reflectance in the NIR wavelengths against chlorophyll absorption in the visible red wavelengths (equation 1).

$$NVDI = \left(\frac{NIR - red}{NIR + red} + 1\right) x\ 100 \qquad \text{(Eq. 1)}$$

We also developed a multi-temporal NDVI layer using four different Landsat Thematic Mapper+ (TM) images from 2005. This layer had a native resolution of 30 m. The combination of NAIP and TM layers was used for the automated classification portion of the mapping process.

We acquired a 10-m digital elevation model (DEM) from the Texas General Land Office (https://www.glo.texas.gov) that became the basis for developing landscape models of aspect, slope, and drainage pattern models to support the mapping. In addition, we used 2014 NAIP and ArcGIS on-line imagery to support later editing of the map. Finally, we acquired a standard set of relevant spatial data layers including digital raster graphics (DRGs) of 1:24,000-scale

USGS topographic maps, roads, ownership, geology (King 1948), and soils (Stahnke 2012). All imagery and other spatial data layers were compiled into a geodatabase and GIS using ArcGIS 10.4 (Esri 2015).

Vegetation Map Units and Legend Development

The development of map units (map classes) and construction of a map legend was an iterative process that integrated the ecological vegetation classification units of the USNVC (plant associations, groups, etc.) described above with their spatial distribution as determined by the quality of the remote sensing imagery and depth of on-the-ground reconnaissance work. We hierarchically structured the legend into two tiers: a basic lower Level 2 composed of map units defined by one or more plant associations from the tables below, and an upper Level 1, which groups the Level 2 map units to the group level of the NVCS (FGDC 2008). For each map unit, the predominant associations are identified as primary components of the unit (collectively greater than 50% of the aerial extent of the unit), while associations known to be less common from ground reconnaissance are designated as secondary components (collectively < 50% of the area). That is, each plot was intersected with the map layer in the GIS, and then each map unit was attributed based on the distribution of plots among plant associations for that provisional unit. While some units were defined by one or two primary plant associations and were relatively simple, others were complexes of plant associations. The map and its legend went through several iterations as ground data were gathered and new imagery was acquired.

Object-oriented Image Classification

An image segmentation technique was used to build the base map. This technique uses an object-oriented method that segments the imagery into objects of similar color, contrast, and shape. The advantage of this approach is that these objects will preserve edge boundaries of detailed surface features such as roads, dunes, and drainages—features that would be lost or misclassified in a pixel-based classification. These objects can then be classified based on their object-derived statistics or turned into polygons for editing and assigned a class value in a GIS by interpreting photos and referring to the pixel-based classification.

The level of detail was controlled by the scale parameter, a unitless abstraction that considers each object based on its homogeneity of color and shape, each of which is weighted from 0 to 1. The smaller the scale factor, the more detail is represented and the more the image is segmented into objects, with a scale factor of 1 theoretically representing individual pixels. Depending on how much the shape factor is weighted, the shape's smoothness and compactness are also considered with each of those subfactors receiving a weighting from 0 to 1. Through an iterative process of adjusting the scale parameter and the other factors, the resulting objects were assessed as to how well they map the features on the ground until a good result is obtained.

The object-oriented map was developed using eCognitition software (https://geospatial.trimble.com/en/products/software/trimble-ecognition) using the aerial and TM imagery and derivative NDVI layers. This resulted in about 71,544 raw objects or polygons for subsequent classification. These objects were then converted into shapefile polygons for use in the GIS.

Supervised Classification

A simultaneous raster-based image classification was conducted using the image dataset. The classification was based on a supervised approach whereby 'seed' polygons were digitally drawn in spectrally homogeneous areas around selected vegetation field plots with the help of the ancillary data, such as field notes and photographs. From these polygons, image statistics were collected to perform a supervised classification. Supervised classifications are based on a maximum likelihood decision rule containing a Bayesian classifier that uses probabilities to weight the classification toward particular classes. In this study, the probabilities were unknown, so the maximum likelihood equation (Equation 2) for each of the classes is given as

$$D = [0.5 \ln (cov_c)] - [0.5 (X - Mc)^T \times (cov_c^{-1}) \times (X - M_c)] \quad \text{(Eq. 2)}$$

where D is the weighted distance, cov_c is the covariance matrix for a particular class, X is the measurement vector of the pixel, M_c is the mean vector of the class and T is the matrix transpose function. Each pixel is then assigned to the class with the lowest weighted distance. This technique assumes the statistical signatures have a normal distribution. This decision rule is considered the most accurate because it not only uses a spectral distance as the

minimum-distance decision rule, it takes into account the variance of each of the signatures. The variance is important when comparing a pixel to a signature representing, for example, a woodland community, which can be fairly heterogeneous due to numerous canopies and noncanopy interspaces as compared to a grassland community, which is more homogeneous.

Final Map Development

The final supervised raster classification was then used to classify the image polygons developed from the object-oriented classification based on the legend described in the tables below. The image objects were imported as a feature of the dataset polygon layer in Esri ArcGIS (v. 10.4; Esri 2015), the file quality controlled, and a topology built. The image polygons were then overlaid onto the recoded raster classification and the majority map unit assigned to each polygon map unit to create the draft final map.

As a final step, the draft final map was subjected to a heads-up screen digitizing edit using the most recent aerial photography (four-band 2014 NAIP and 2016 NAIP). During the final edit, the thematic composition and number of Level 1 and 2 map units (Tables 5 and 6a–6Q) were finalized and the final map product was produced using NPS cartographic standards. While the minimum mapping requirements were at 1:24,000 scale with map unit delineations or polygons at 1.24 acres (0.5 ha) or larger, most of the final line work was completed at an operational scale between 1:12,000 and 1:3,000. Hence, polygons down to 0.25 acres (0.1 ha) were often maintained. For final map production, adjacent polygons of the same class were merged and remaining polygons less than 0.25 acres (0.1 ha) were subsumed into neighboring polygons based on longest shared boundary. Final map products were compiled into a geodatabase for NPS and poster maps were produced at Level 1 and 2 following NPS cartographic standards.

Mapping Results

Vegetation Map and Map Legend

The Guadalupe Mountains NP vegetation map is presented in Figure 11a and the legend is in Figure 11b and is composed of 16 Level 1 (L1) vegetation units that correspond to the group level of USNVC plus one miscellaneous other land cover class (Tables 5 and 6A–6Q). Within each L1 unit there are one or more Level 2 (L2) units defined in terms of component plant associations— primary components and secondary components tied to the USNVC in Tables 4A–4L. The L2 map is presented in Figure 12a and the legend is in Figure 12b and has 48 L2 units per Tables 5 and 6A–6Q. While some units are more heterogeneous than others, an attempt was made to keep the map units as monophyletic as possible to minimize the overlap of associations from one unit to the next. The map unit name reflects the primary component associations of the unit. In addition, the component structure of most of the Level 2 units typically reflects the geomorphic context such as dune, basin, etc. A complete annotated legend with summary descriptions of the units, distribution maps, aerial photo examples of map unit polygons, and representative photos is provided in Appendix D. Full-size maps at 1:34,500-scale are available as both a PDF and a shape file for GIS use at https://www.nps.gov/im/vegetation-inventory.htm.

Mapping Discussion

The complex combination of geology and soils, along with the steep elevation gradient, has created the diverse vegetation pattern characteristic of Guadalupe Mountains NP. In particular, the high degree of thematic resolution provided in the Level 2 units with their reference to component plant associations was directed towards delineating variation among grasslands and forest units. The high thematic content was intended to inform our understanding of current vegetation patterns as they may reflect the ecological processes, many of which are described above in the context of the vegetation classification. Overall, the combination of the annotated legend (Appendix D) and the detailed floristic and site descriptions of individual plant associations (Appendix C) provides for a vegetation map that is rich in ecological information and one that can serve multiple purposes in the management of the park and the broader network of parks.

Table 5. Hierarchical map unit legend for the Guadalupe Mountains NP vegetation map. See text for definition of map unit Levels 1 and 2. "# of polygons" refers to the number of polygon delineations for that map unit at that level. Total areas for the map units by level are given in hectares and acres.

Level 1 and Level 2 Map Units	# of Polygons	Area	
		Hectares	Acres
1 Madrean Upper Montane Conifer - Oak Forest & Woodland	**616**	**2779**	**6866**
1A Madrean Upper Montane Conifer - Oak Woodland Savanna	251	831.9	2056
1B Madrean Upper Montane Conifer - Oak Dry Forest	263	1147	2834
1C Madrean Upper Montane Conifer - Oak - Maple Moist Mesic Forest	102	799.8	1976
2 Madrean Lower Montane Pine - Oak Forest & Woodland	**156**	**505.7**	**1250**
2A Madrean Ponderosa Pine / Gambel and Wavyleaf Oak Woodland	117	349.3	863.1
2B Madrean Lower Montane Ponderosa Pine - Bigtooth Maple - Chinkapin Oak Canyon Woodland	39	156.5	386.6
3 Madrean Pinyon - Juniper Woodland	**431**	**1382**	**3416**
3A Madrean Two-needle Pinyon - Alligator Juniper / New Mexico Muhly Woodland	91	228.9	565.6
3B Madrean Two-needle Pinyon - Alligator Juniper / Finestem Needlegrass - Blue Grama Woodland Savanna	42	249.2	615.7
3C Madrean Two-needle Pinyon - Alligator Juniper / Wavyleaf Oak - Mountain Mahogany Woodland	298	904.4	2235
4 Madrean Encinal	**258**	**624.4**	**1543**
4A Madrean Gray Oak - Alligator Juniper Foothill Woodland Savanna	68	229.6	567.2
4B Madrean Gray Oak - Alligator Juniper Canyon and Dry Wash Woodland	190	394.8	975.6
5 Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland	**61**	**122.1**	**301.7**
5A Gambel Oak - New Mexico Locust Shrubland	61	122.1	301.7
6 Eastern Madrean Chaparral	**864**	**7217**	**17834**
6A Pinchot's Juniper - Scrub Oak / Curlyleaf Muhly Shrubland	159	1028	2541
6B Pungent Oak - Wavyleaf Oak Shrubland	469	2892	7146
6C Mountain Mahogany Shrubland	172	2349	5805
6D Pungent Oak / Bull Muhly Foothill Shrubland and Grassland	64	947.4	2341
7 Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland	**1045**	**7502**	**18537**
7A Arizona Fescue - Blue Grama Montane Grassland	7	14.83	36.63
7B Needlegrass Foothill Grasslands	36	75.21	185.9
7C Finestem Needlegrass - Blue Grama Valley Grassland	37	132.1	326.4
7D Curlyleaf Muhly Foothill Semi-Desert Grassland	116	1273	3145
7E Green Sotol - Sacahuista Foothill Semi-Desert Grassland	174	1508	3727
7F Skeletonleaf Goldeneye - Mariola / Grama Grass Foothill Semi-Desert Grassland	210	2952	7296
7G Grama Grass Piedmont Grasslands with Pinchot's Juniper or Littleleaf Sumac	60	185.8	459.1
7H Grama Grass Piedmont Grassland	56	221.1	546.3
7I Black Grama - Mixed Grasses Piedmont Semi-Desert Grassland	235	810.2	2002
7J Catclaw Mimosa / Sideoats Grama Semi-Desert Grassland	114	328.9	812.6
8 Chihuahuan Gypsophilous Grassland	**488**	**1248**	**3084**
8A Gypsum Dune Semi-Desert Grassland	36	220.2	544.1
8B Gypsum Flat Dropseed Grassland	117	255.8	632.1
8C Gypsum Flat Semi-Desert Grassland	335	772.0	1908

Table 5 (continued). Hierarchical map unit legend for the Guadalupe Mountains NP vegetation map. See text for definition of map unit Levels 1 and 2. # of polygons" refers to the number of polygon delineations for that map unit at that level. Total areas for the map units by level are given in hectares and acres.

Level 1 and Level 2 Map Units	# of Polygons	Area	
		Hectares	Acres
9 Chihuahuan Gypsophilous Scrub	**350**	**1828**	**4516**
9A Frosted Mint Gypsum Dune Desert Scrub	64	503.5	1244
9B Fourwing Saltbush Gypsum Desert Scrub	286	1324	3272
10 Chihuahuan Desert Succulent Scrub	**227**	**2573**	**6359**
10A Mariola - Goldeneye - Ocotillo Desert Scrub	227	2573	6359
11 Chihuahuan Creosotebush - Mixed Desert Scrub	**836**	**7004**	**17308**
11A Viscid Acacia Desert Scrub	86	366.6	905.8
11B Fourwing Saltbush Desert Scrub	22	904.4	2235
11C Creosotebush Desert Scrub	385	2371	5859
11D Creosotebush Desert Scrub with Honey Mesquite	296	1491	3685
11E Broom Dalea - Honey Mesquite Coppice Dune	47	1871	4624
12 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope	**586**	**2013**	**4975**
12A Mexican Buckeye - Oak Desert Canyon Shrubland	211	362.2	895.0
12B Apache Plume - Desert Willow Dry Wash Riparian Shrubland	86	363.6	898.5
12C Chihuahuan Desert Scrub Dry Wash Riparian Shrubland	289	1288	3182
13 Western Interior Riparian Forest & Woodland	**12**	**51.79**	**128.0**
13A Mixed Riparian Woodland and Shrubland	12	51.79	128.0
14 Arid West Interior Freshwater Marsh	**4**	**6.578**	**16.26**
14A Herbaceous Wetland	4	6.578	16.26
15 North American Warm Desert Ruderal Grassland	**19**	**16.92**	**41.80**
15A Ruderal Grassland	19	16.92	41.80
16 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation	**151**	**742.3**	**1834**
16A Sparse Vegetation - Rockland / Scarp / Cliff	151	742.3	1834
17 Built-up Land - Miscellaneous	**58**	**155.6**	**384.4**
17A Road	10	98.46	243.3
17B Recreation Site	6	4.632	11.44
17C Agriculture / Old Field	2	1.739	4.297
17D Residential / Built-up Vegetation	8	16.81	41.54
17E Sparse Vegetation - Bare Soil / Disturbed Ground	32	33.93	83.85

Table 6A. Level 2 plant associations within Level 1 Map Unit: 1 Madrean Upper Montane Conifer - Oak Forest & Woodland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
1A Madrean Upper Montane Conifer - Oak Woodland Savanna	*Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest	*1*	CEPP006999
	Pseudotsuga menziesii / Muhlenbergia pauciflora Forest	*1*	CEPP007098
	Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum Forest	*1*	CEPP007000
	Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica Forest	*2*	CEPP006998
	Pinus strobiformis / Festuca arizonica Forest	*2*	CEPP006988
1B Madrean Upper Montane Conifer - Oak Dry Forest	*Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest	*1*	CEPP006997
	Pseudotsuga menziesii - Ostrya knowltonii Forest	*2*	CEPP006996
1C Madrean Upper Montane Conifer - Oak - Maple Moist Mesic Forest	*Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii* Forest	1	CEPP006995
	Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii Forest	1	CEPP006993
	Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii Forest	1	CEPP006994
	Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii Forest	1	CEPP006986
	Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii Forest	1	CEPP006984
	Pinus strobiformis - Acer grandidentatum - Quercus gambelii Forest	1	CEPP006985
	Pinus strobiformis - Quercus muehlenbergii Forest	2	CEPP006987
	Populus tremuloides - Pinus strobiformis / Ostrya knowltonii Forest	2	CEPP006991
	Acer grandidentatum - Quercus muehlenbergii Forest	2	CEGL004547
	Acer grandidentatum / Quercus gambelii Forest	2	CEGL000559

Table 6B. Level 2 plant associations within Level 1 Map Unit: 2 Madrean Lower Montane Pine - Oak Forest & Woodland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
2A Madrean Ponderosa Pine / Gambel and Wavyleaf Oak Woodland	*Pinus ponderosa / Muhlenbergia pauciflora* Forest	*1*	CEPP006980
	Pinus ponderosa / Quercus gambelii / Piptochaetium fimbriatum Forest	*1*	CEPP006981
	Pinus ponderosa - Quercus gambelii / Festuca arizonica Forest	*2*	CEPP006979
	Pinus ponderosa / Quercus × pauciloba / Muhlenbergia pauciflora Forest	*2*	CEPP006982
	Pinus ponderosa / Quercus × pauciloba / Piptochaetium fimbriatum Forest	2	CEPP006983
2B Madrean Lower Montane Ponderosa Pine - Bigtooth Maple - Chinkapin Oak Canyon Woodland	*Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii* Forest	*1*	CEPP006978
	Acer grandidentatum - Quercus muehlenbergii Forest	*1*	CEGL004547
	Acer grandidentatum / Quercus gambelii Forest	*2*	CEGL000559

Table 6C. Level 2 plant associations within Level 1 Map Unit: 3 Madrean Pinyon - Juniper Woodland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
3A Madrean Two-needle Pinyon - Alligator Juniper / New Mexico Muhly Woodland	*Pinus edulis / Muhlenbergia pauciflora* Woodland	*1*	CEGL000785
	Juniperus deppeana / Muhlenbergia pauciflora Woodland	*1*	CEPP006891
	Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum Woodland	*2*	CEPP006947
	Pinus edulis / Muhlenbergia setifolia Woodland	*2*	CEPP006971
3B Madrean Two-needle Pinyon - Alligator Juniper / Finestem Needlegrass - Blue Grama Woodland Savanna	*Pinus edulis / Nassella tenuissima* Woodland	1	CEPP006972
	Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis Open Woodland	1	CEGL002151
	Juniperus deppeana / Bouteloua gracilis Woodland	1	CEGL000693
3C Madrean Two-needle Pinyon - Alligator Juniper / Wavyleaf Oak - Mountain Mahogany Woodland	*Pinus edulis / Quercus* × *pauciloba (Cercocarpus montanus* var. *paucidentatus) / Muhlenbergia pauciflora* Woodland	1	CEPP006977
	Juniperus deppeana / Quercus × *pauciloba / Bouteloua curtipendula* Woodland	1	CEPP006892

Table 6D. Level 2 plant associations within Level 1 Map Unit: 4 Madrean Encinal. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
4A Madrean Gray Oak - Alligator Juniper Foothill Woodland Savanna	*Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi (Bouteloua* spp.) Woodland	*1*	CEPP007106
	Juniperus deppeana / Quercus x *pauciloba / Bouteloua curtipendula* Woodland	*2*	CEPP006892
4B Madrean Gray Oak - Alligator Juniper Canyon and Dry Wash Woodland	*Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora* Woodland	*1*	CEPP007144
	Quercus grisea - Arbutus xalapensis Woodland	*1*	CEPP007103
	Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi (Bouteloua spp.) Woodland	*1*	CEPP007106
	Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum Woodland	2	CEPP007146
	Fallugia paradoxa Desert Wash Shrubland	2	CEGL002716
	Dry Wash	2	NHNM000402

Table 6E. Level 2 plant associations within Level 1 Map Unit: 5 Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
5A Gambel Oak - New Mexico Locust Shrubland	*Quercus gambelii / Robinia neomexicana* Shrubland	*1*	CEGL001115
	Quercus gambelii / Piptochaetium fimbriatum - Festuca arizonica Woodland	*1*	CEPP007101
	Robinia neomexicana / Piptochaetium fimbriatum Shrubland	*1*	CEPP007155
	Quercus gambelii / Carex inops Shrubland	*2*	CEGL001112

Table 6F. Level 2 plant associations within Level 1 Map Unit: 6 Eastern Madrean Chaparral. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
6A Pinchot's Juniper - Scrub Oak / Curlyleaf Muhly Shrubland	*Juniperus pinchotii / Quercus (pungens,* x *pauciloba) / Muhlenbergia setifolia* Woodland	*1*	CEPP006893
	Quercus pungens / Muhlenbergia setifolia Shrubland	*2*	CEPP007152
6B Pungent Oak - Wavyleaf Oak Shrubland	*Quercus (pungens,* × *pauciloba) / Muhlenbergia pauciflora* Shrubland	*1*	CEPP007149
	Quercus x *pauciloba / Cercocarpus montanus* Shrubland	*1*	CEGL001118
	Quercus x *pauciloba / Achnatherum lobatum* Shrubland	*2*	CEPP007153
	Rockland	*2*	–
6C Mountain Mahogany Shrubland	*Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland	1	CEGL001089
	Cercocarpus montanus / Muhlenbergia setifolia Shrubland	2	CEPP006879
	Rockland	2	–
6D Pungent Oak / Bull Muhly Foothill Shrubland and Grassland	*Quercus (pungens,* × *pauciloba) / Muhlenbergia emersleyi* Shrubland	1	CEPP007148
	Quercus pungens / Bouteloua gracilis Shrubland	2	CEPP007150
	Rockland	2	–

Table 6G. Level 2 plant associations within Level 1 Map Unit: 7 Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
7A Arizona Fescue - Blue Grama Montane Grassland	*Festuca arizonica - Bouteloua gracilis* Grassland	*1*	CEPP006886
7B Needlegrass Foothill Grasslands	*Achnatherum lobatum - Bouteloua curtipendula* Grassland	*1*	CEPP006871
	Hesperostipa neomexicana - Bouteloua curtipendula Grassland	*2*	CEGL001709
7C Finestem Needlegrass - Blue Grama Valley Grassland	*Nassella tenuissima - Bouteloua gracilis* Grassland	*1*	CEPP006931
	Bouteloua gracilis - Panicum obtusum Grassland	*2*	CEPP006878
	Bouteloua gracilis - Bouteloua curtipendula Grassland	*2*	CEGL001754
	Bouteloua hirsuta - Bouteloua curtipendula Grassland	*2*	CEGL001764
7D Curlyleaf Muhly Foothill Semi-Desert Grassland	*Dasylirion leiophyllum / Muhlenbergia setifolia* Shrub Grassland	1	CEPP006884
	Nolina (texana, microcarpa) / Muhlenbergia setifolia Shrub Grassland	1	CEPP006934
	Dasylirion leiophyllum - Agave lechuguilla / Muhlenbergia setifolia Shrub Grassland	2	CEPP006881
7E Green Sotol - Sacahuista Foothill Semi-Desert Grassland	*Dasylirion leiophyllum / Muhlenbergia emersleyi* Shrub Grassland	1	CEPP006883
	Dasylirion leiophyllum / Bouteloua curtipendula Shrub Grassland	1	CEPP006882
	Hesperostipa neomexicana - Dasylirion wheeleri Grassland	1	CEGL001710
	Nolina (texana, microcarpa) / Muhlenbergia emersleyi Shrub Grassland	2	CEPP006933
	Nolina (texana, microcarpa) / Bouteloua eriopoda Shrub Grassland	2	CEPP006932
	Viguiera stenoloba / Muhlenbergia pauciflora Shrub Grassland	2	CEPP007506

Table 6G (continued). Level 2 plant associations withinLevel 1 Map Unit: 7 Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
7F Skeletonleaf Goldeneye - Mariola / Grama Grass Foothill Semi-Desert Grassland	*Viguiera stenoloba / Bouteloua curtipendula* Shrub Grassland	1	CEPP007492
	Viguiera stenoloba / Bouteloua eriopoda Shrub Grassland	1	CEPP007501
	Viguiera stenoloba / Bouteloua gracilis Shrub Grassland	1	CEPP007516
	Parthenium incanum / Bouteloua eriopoda Shrub Grassland	1	CEGL001734
	Fouquieria splendens / Bouteloua curtipendula Shrub Grassland	2	CEPP006888
	Fouquieria splendens / Bouteloua eriopoda Shrub Grassland	2	CEPP006889
7G Grama Grass Piedmont Grasslands with Pinchot's Juniper or Littleleaf Sumac	*Bouteloua gracilis - Bouteloua curtipendula* Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases	1	CEGL001754
	Bouteloua eriopoda - Bouteloua gracilis Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases	1	CEGL001748
	Yucca elata / Bouteloua eriopoda Shrub Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases	2	CEGL001735
7H Grama Grass Piedmont Grassland	*Bouteloua eriopoda - Bouteloua gracilis* Grassland	1	CEGL001748
	Yucca elata / Bouteloua eriopoda - Bouteloua gracilis Shrub Grassland	1	CEPP007518
	Yucca elata / Bouteloua eriopoda Shrub Grassland	1	CEGL001735
	Muhlenbergia setifolia - Bouteloua eriopoda Grassland	2	CEPP006930
	Bouteloua eriopoda - Hesperostipa neomexicana Grassland	2	CEGL001753
	Yucca elata / Bouteloua gracilis Shrub Grassland	2	CEPP007520
7I Black Grama - Mixed Grasses Piedmont Semi-Desert Grassland	*Bouteloua eriopoda - Muhlenbergia porteri* Grassland	1	CEPP006877
	Bouteloua eriopoda - Bouteloua curtipendula Grassland	1	CEGL001747
	Yucca torreyi / Bouteloua eriopoda Shrub Grassland	1	CEPP007523
	Agave lechuguilla / Bouteloua eriopoda Dwarf-shrubland	2	CEPP006872
	Tiquilia hispidissima / Dasyochloa pulchella Dwarf-shrub Grassland	2	CEPP007490
	Krameria grayi / Dasyochloa pulchella Dwarf-shrub Grassland	2	CEPP006894
7J Catclaw Mimosa / Sideoats Grama Semi-Desert Grassland	*Mimosa aculeaticarpa* var. *biuncifera / Bouteloua curtipendula* Shrub Grassland	1	CEPP006898

Table 6H. Level 2 plant associations within Level 1 Map Unit: 8 Chihuahuan Gypsophilous Grassland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
8A Gypsum Dune Semi-Desert Grassland	*Ephedra torreyana / Bouteloua breviseta* Dwarf-shrub Grassland	*1*	CEPP007425
	Tiquilia hispidissima / Bouteloua breviseta - Sporobolus nealleyi Shrub Grassland	*2*	CEPP007487
8B Gypsum Flat Dropseed Grassland	*Sporobolus nealleyi - Sporobolus airoides* Grassland	*1*	CEPP007465
	Sporobolus airoides Monotype Wet Meadow	*2*	CEGL001688
8C Gypsum Flat Semi-desert Grassland	*Tiquilia hispidissima / Sporobolus nealleyi* Dwarf-shrubland	1	CEGL001546
	Tiquilia hispidissima / Sartwellia flaveriae Dwarf-shrubland	2	CEPP007491

Table 6I. Level 2 plant associations within Level 1 Map Unit: 9 Chihuahuan Gypsophilous Scrub. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
9A Frosted Mint Gypsum Dune Desert Scrub	*Poliomintha incana / Andropogon hallii* Shrubland	*1*	CEPP006989
	Poliomintha incana / Bouteloua breviseta Gypsophilous Shrubland	1	CEPP007438
	Poliomintha incana / Sporobolus flexuosus Shrubland	1	CEPP006990
9B Fourwing Saltbush Gypsum Desert Scrub	*Atriplex canescens / Sporobolus airoides / Sartwellia flaveriae* Shrubland	*1*	CEPP006875
	Atriplex canescens / Muhlenbergia porteri - Sartwellia flaveriae Shrubland	*1*	CEPP006873
	Atriplex canescens / Sporobolus nealleyi Shrubland	*2*	CEPP007287
	Sporobolus airoides Monotype Wet Meadow	2	CEGL001688

Table 6J. Level 2 plant associations within Level 1 Map Unit: 10 Chihuahuan Desert Succulent Scrub. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
10A Mariola - Goldeneye - Ocotillo Desert Scrub	*Viguiera stenoloba / Parthenium incanum* Shrubland	*1*	CEPP007514
	Fouquieria splendens - Tiquilia greggii Shrubland	*1*	CEPP006887
	Fouquieria splendens / Parthenium incanum Shrubland	*1*	CEGL001378
	Mortonia scabrella - Parthenium incanum Shrubland	*2*	CEPP006899

Table 6K. Level 2 plant associations within Level 1 Map Unit: 11 Chihuahuan Creosotebush - Mixed Desert Scrub. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
11A Viscid Acacia Desert Scrub	*Acacia neovernicosa / Bouteloua eriopoda* Shrubland	*1*	CEPP006869
	Acacia neovernicosa - Agave lechuguilla Shrubland	*2*	CEPP006868
11B Fourwing Saltbush Desert Scrub	*Atriplex canescens / Sporobolus airoides* Shrubland	*1*	CEGL001291
	Atriplex canescens / Sporobolus (flexuosus, cryptandrus, contractus) Shrubland	*2*	CEPP006874
	Sporobolus airoides Monotype Wet Meadow	*2*	CEGL001688
11C Creosotebush Desert Scrub	*Larrea tridentata / Bouteloua eriopoda* Shrubland	1	CEGL001265
	Larrea tridentata - Parthenium incanum Shrubland	1	CEGL001274
	Larrea tridentata / Sparse Understory Shrubland	1	CEGL001276
	Larrea tridentata - Krameria grayi Shrubland	2	CEPP006896
	Larrea tridentata / Sporobolus flexuosus Shrubland	2	CEPP006897
	Larrea tridentata - Flourensia cernua Sparse Shrubland	2	CEPP006895
	Larrea tridentata / Sporobolus airoides Shrubland	2	CEGL001277

Table 6K (continued). Level 2 plant associations within Level 1 Map Unit: 11 Chihuahuan Creosotebush - Mixed Desert Scrub. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
11D Creosotebush Desert Scrub with Honey Mesquite	*Larrea tridentata* / *Bouteloua eriopoda* Shrubland, *Prosopis glandulosa* phase	1	CEGL001265
	Larrea tridentata / *Bouteloua gracilis* Shrubland, *Prosopis glandulosa* phase	1	CEGL001266
	Larrea tridentata / Sparse Understory Shrubland, *Prosopis glandulosa* phase	1	CEGL001276
	Larrea tridentata / *Muhlenbergia porteri* Shrubland, *Prosopis glandulosa* phase	2	CEGL001272
11E Broom Dalea - Honey Mesquite Coppice Dune	*Prosopis glandulosa* / *Sporobolus flexuosus* Ruderal Shrubland	1	CEGL001386
	Psorothamnus scoparius / *Sporobolus flexuosus* Shrubland	2	CEGL001695
	Prosopis glandulosa / *Sporobolus airoides* Shrubland	2	CEGL001385

Table 6L. Level 2 plant associations within Level 1 Map Unit: 12 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
12A Mexican Buckeye - Oak Desert Canyon Shrubland	*Fallugia paradoxa* / *Ungnadia speciosa* Shrubland	*1*	CEGL002719
	Dry Wash	*2*	NHNM000402
12B Apache Plume - Desert Willow Dry Wash Riparian Shrubland	*Fallugia paradoxa* Desert Wash Shrubland	*1*	CEGL002716
	Fallugia paradoxa - *Brickellia laciniata* Desert Wash Shrubland	*1*	CEPP006885
	Juglans microcarpa - *Fallugia paradoxa* / *Bouteloua curtipendula* Desert Wash Shrubland	*2*	CEPP006890
	Chilopsis linearis - *Fallugia paradoxa* Desert Wash Shrubland	2	CEPP006880
	Dry Wash	2	NHNM000402
12C Chihuahuan Desert Scrub Dry Wash Riparian Shrubland	*Larrea tridentata* - *Flourensia cernua* Sparse Shrubland	1	CEPP006895
	Larrea tridentata / *Muhlenbergia porteri* Shrubland	1	CEGL001272
	Flourensia cernua / *Muhlenbergia porteri* Shrubland	2	CEPP007428
	Prosopis glandulosa Desert Wash Shrubland	2	CEPP006992
	Dry Wash	2	NHNM000402

Table 6M. Level 2 plant associations within Level 1 Map Unit: 13 Western Interior Riparian Forest & Woodland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
13A Mixed Riparian Woodland and Shrubland	*Acer grandidentatum* - *Quercus muehlenbergii* Forest	*1*	CEGL004547
	Acer grandidentatum - *Quercus grisea* Forest	*1*	CEPP006870
	Populus deltoides / *Muhlenbergia asperifolia* Flooded Forest	*2*	CEGL000678
	Dry Wash	*2*	NHNM000402

Table 6N. Level 2 plant associations within Level 1 Map Unit: 14 Arid West Interior Freshwater Marsh. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
14A Herbaceous Wetland	*Schoenoplectus americanus* Western Marsh	*1*	CEGL001841

Table 6O. Level 2 plant associations within Level 1 Map Unit: 15 North American Warm Desert Ruderal Grassland. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
15A Ruderal Grassland	*Setaria leucopila* / *Solanum elaeagnifolium* Grassland	*1*	CEPP007484
	Bouteloua gracilis Ruderal Grassland	*1*	CEPS009501
	Disturbed / Tank	*2*	NHNM000397

Table 6P. Level 2 plant associations within Level 1 Map Unit: 16 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
16A Sparse Vegetation - Rockland / Scarp / Cliff	–	–	–

Table 6Q. Level 2 plant associations within Level 1 Map Unit: 17 Built-up Land - Miscellaneous. "Component level" indicates that plant association is designated either as a primary (1) or a secondary (2) component (see text for detail).

Level 2 Map Unit	Association	Component Level	Code
17A Road	–	–	–
17B Recreation Site	–	–	–
17C Agriculture / Old Field	–	–	–
17D Residential / Built-up Vegetation	–	–	–
17E Sparse Vegetation - Bare Soil / Disturbed Ground	–	–	–

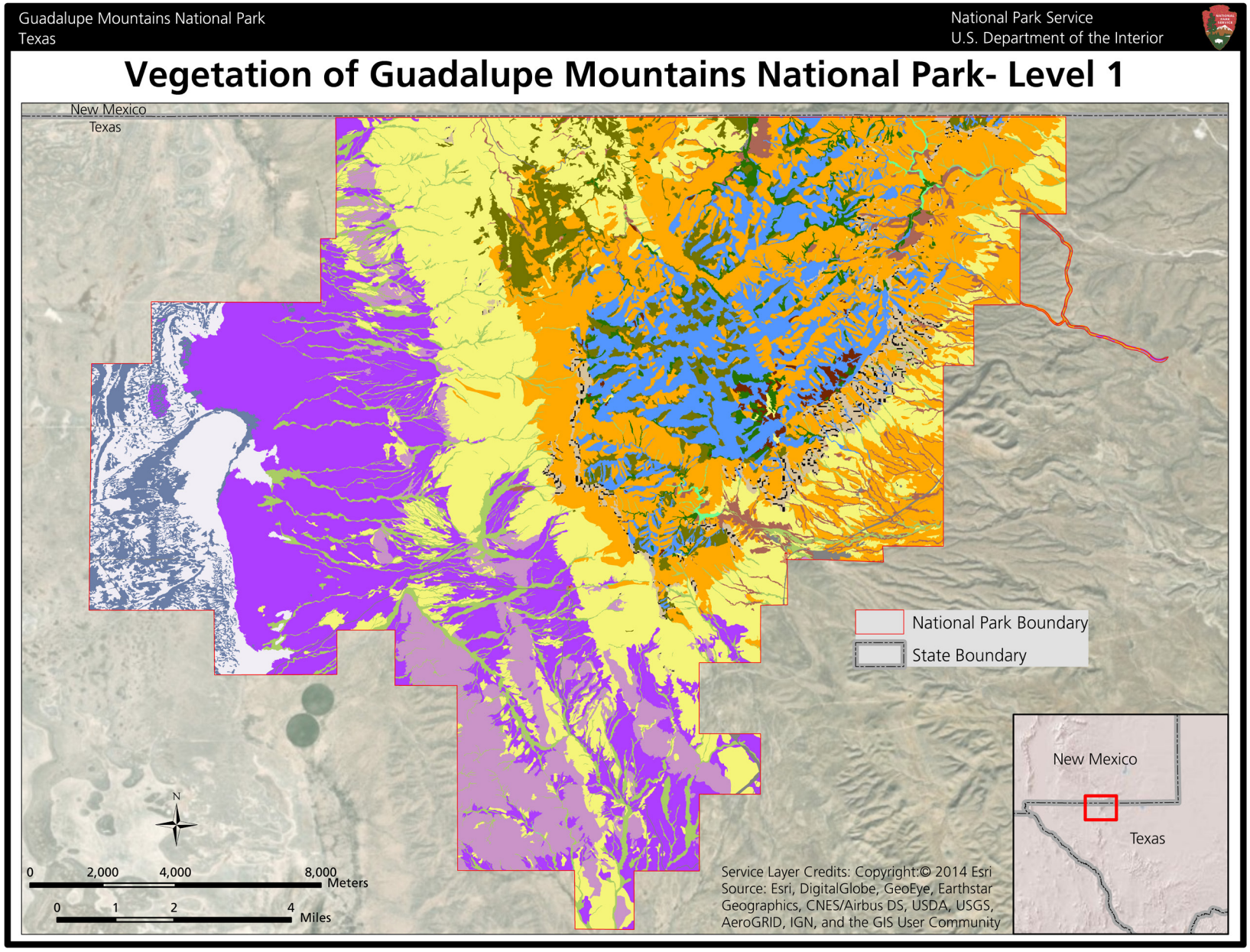


Figure 11a. The vegetation map of Guadalupe Mountains National Park portraying the Level 1 units (see Tables 5 and 6A-6Q and Appendix D for map unit definitions). A full-scale version of this map is available at https://www.nps.gov/im/vegetation-inventory.htm. See Figure 11b for the map legend.

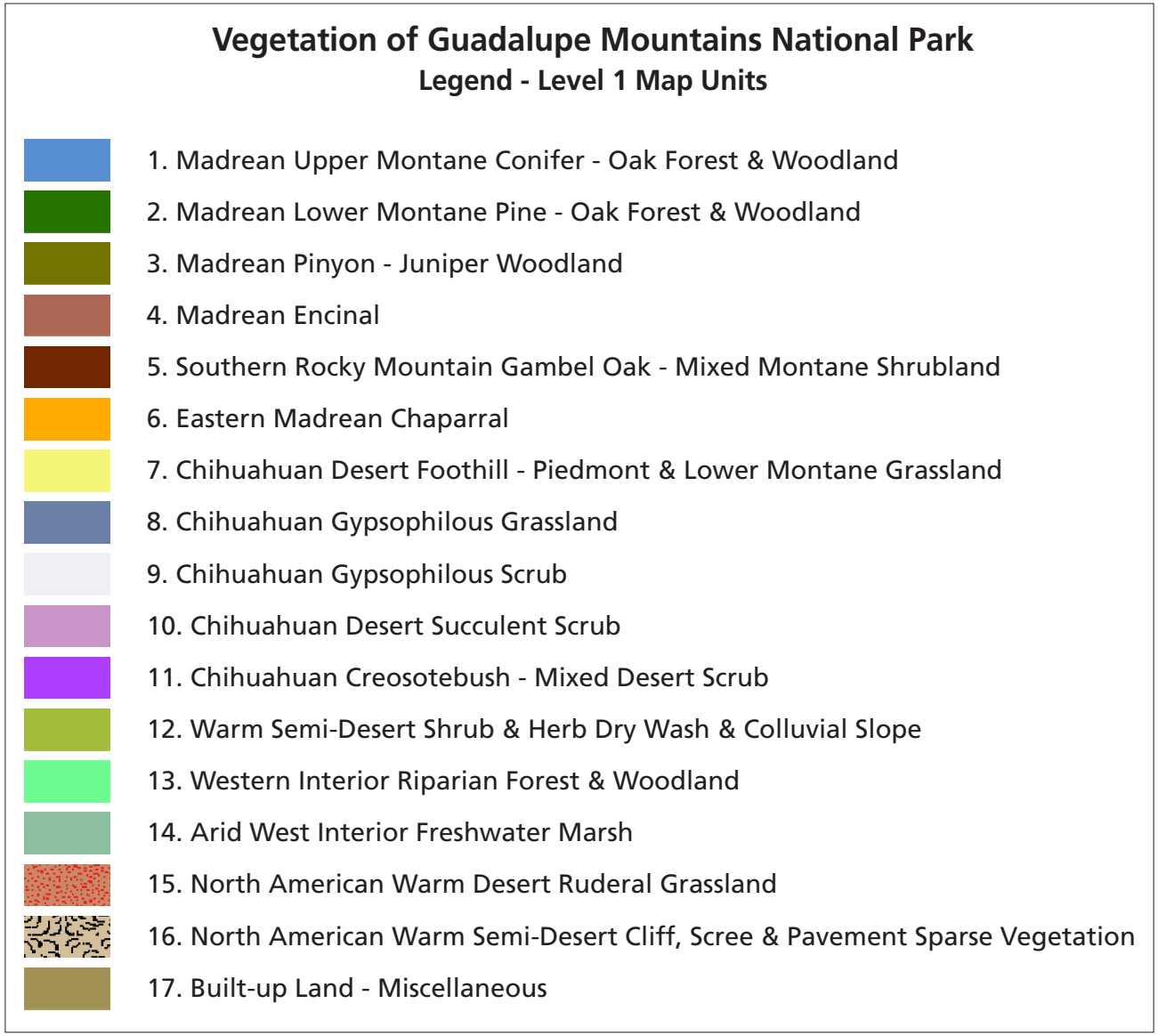


Figure 11b. Legend for the vegetation map of Guadalupe Mountains National Park in Figure 11a portraying the Level 1 units (see Tables 5 and 6A-6Q and Appendix D for map unit definitions).

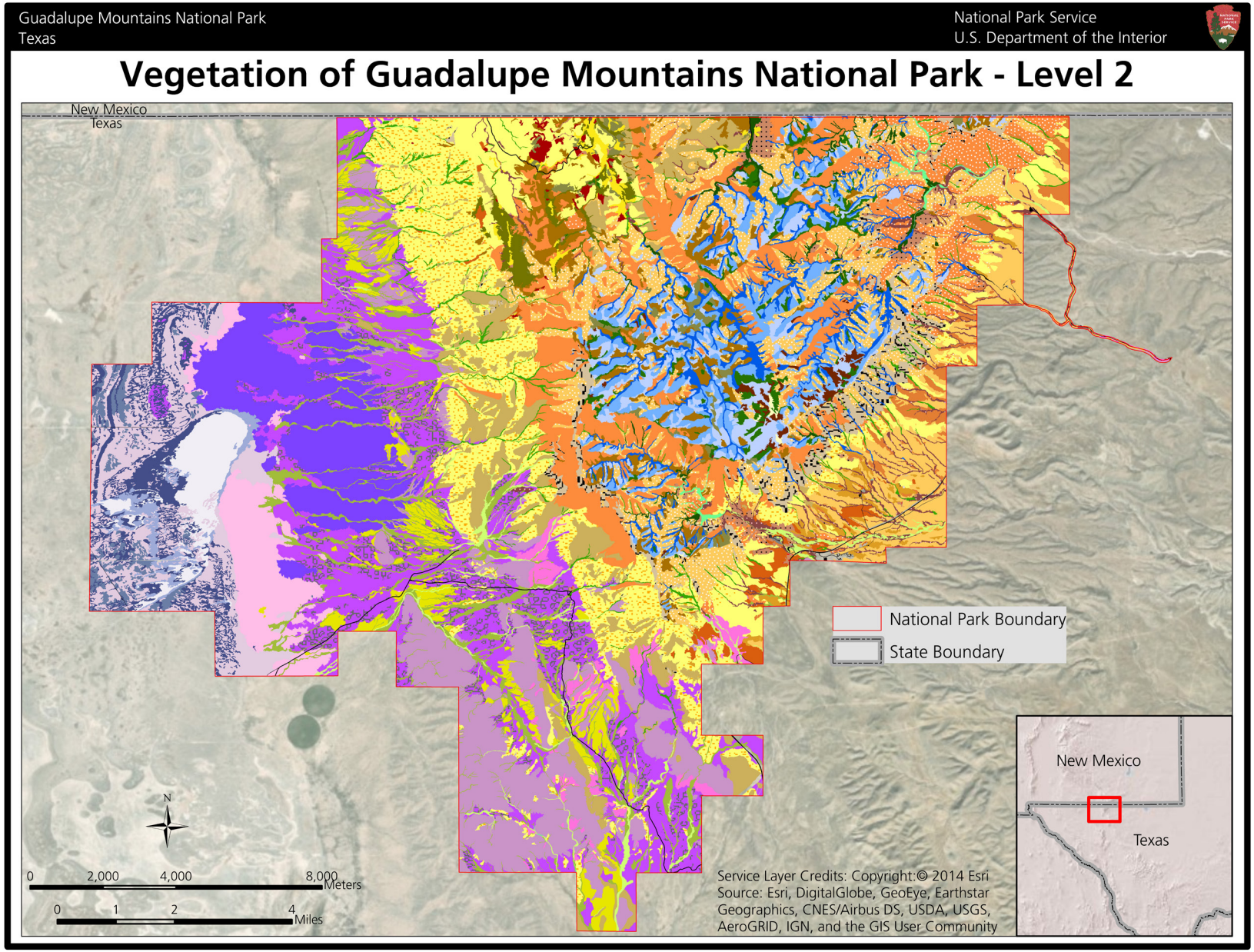


Figure 12a. The vegetation map of Guadalupe Mountains National Park portraying the Level 2 units (see Tables 5 and 6A-6Q and Appendix D for map unit definitions). A full-scale version of this map is available at https://www.nps.gov/im/vegetation-inventory.htm. See Figure 12b for the map legend.



Figure 12b. Legend for the vegetation map of Guadalupe Mountains National Park (Figure 12a) portraying the Level 2 units (see Tables 5 and 6A-6Q and Appendix D for map unit definitions).

Chapter 4: Accuracy Assessment

The thematic accuracy of the Guadalupe Mountains NP vegetation map was conducted by staff from the University of Texas, Lady Bird Johnson Wildflower Center (LBJWC). Work was completed over four separate field periods totaling 25 days between November 2013 and October 2014. The broad approach followed the TNC-NPS (The Nature Conservancy-National Park Service) guidelines (Lea and Curtis 2010) by drawing accuracy assessment (AA) sites stratified by draft map class and equal-probability sites within those areas, buffered away from polygon edges so the results estimate the accuracy of labels assigned to the core of polygons but not of the linework distinguishing between adjacent map classes that might well grade into each other.

Logistical constraints lowered the capacity of the 8-person team to implement the NPS guidelines (Lea and Curtis 2010). The major difference was that the sample sizes per map class were much smaller than the 25 or 30 recommended. This means that the estimated map class-specific accuracies and even the overall map accuracy have substantial uncertainty about them.

Further, to reduce travel time to sites, sites were restricted to be "within one kilometer or less of a passable road or trail and not blocked by slopes >30%" (see Appendix E). This excluded much of the map from actual accuracy assessment, and fully excluded one map class (7F) that covers approximately 8% of the park in its entirety. Access from private landowners on the eastern portion of the park was not obtained, further restricting sampling of those regions.

To the extent that the easily accessible map polygons are representative of map polygons of their respective map classes across the entire park, the accuracy estimates may be applicable to the entire map. But, note that these same easy-access areas were where many of the same areas were heavily sampled during the classification phase (Chapter 2, Figure 10). Therefore, the areas with the highest confidence in class development were also the ones sampled during AA—potentially biasing accuracy estimates upward by avoiding areas with more ambiguous relationships to the map classes.

It should be emphasized that these issues are with the AA methodology and do not reflect poorly on the quality of the mapping nor on the classified vegetation types. As performed, the AA results somewhat limit what can be proven about the accuracy and quality of the map, as is discussed in more detail in the results and discussion sections below.

The goal of the NPS Vegetation Mapping Inventory (VMI) Program is to achieve overall and individual map unit accuracies greater than 80% from both producers' and users' perspectives. LBJWC tested both Level 1 (NVCS group) and Level 2 (map unit) of the legend hierarchy against their field collected data. We report the results of the accuracy assessment here and make recommendations on the use of the map in the context of the accuracy estimates detected among the map units at two levels of map class.

Positional accuracy is usually omitted from NPS National Vegetation Mapping Program products because vegetation seldom splits along discrete edges that can be positively located in the field. The subjectivity involved in this effort, plus the high resolution and accuracy of the ortho-photo imagery, usually permits the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (±10 m; ±30 feet). Qualitatively minor deviations were seen from image date to image date, but given that resources were limited, we did not assess the positional accuracy further.

Accuracy Assessment Methods

Sampling

The LBJWC crew set a goal to sample a minimum of 300 sites, with a maximum of 10 plots per vegetation classification code where codes were akin to the Level 2 map classes. No minimum number of plots per class was set, even though Lea and Curtis (2010) provide guidelines for this. A total of 345 0.5-ha plots were sampled with plots chosen based on their accessibility as stated above (Figure 13). Four plots were excluded from the analysis as they overlapped with other plots and were considered duplicates, leading to 341 out of 345 total samples for assessment. These were sampled as quick plots as described in Chapter 2.

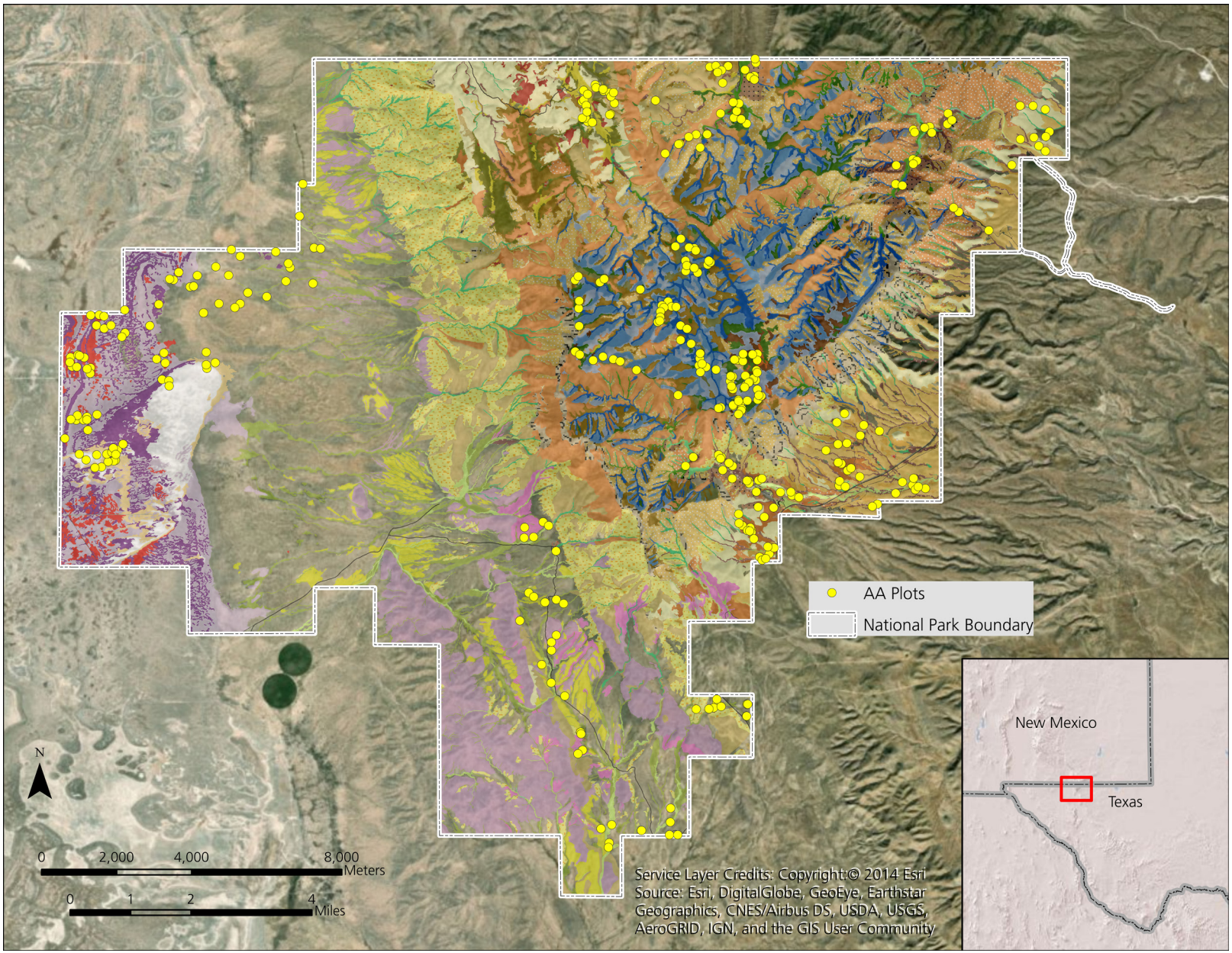


Figure 13. Distribution of 345 accuracy assessment plots collected by Clary and Waitt (2016; Appendix E of this report) for the Guadalupe Mountains National Park vegetation map.

Field Methods

Dominant species and their canopy cover were recorded at each AA point along with four documentary photographs. Following the NPS guidelines, multiple samples were allowed within any given delineated polygon and were considered independent samples. In effect, each sample is intended to represent a pseudopolygon at the minimum map unit size of 0.5 ha. But at the polygon level, there was a relatively high incidence of multiple samples where 226 of the 341 AA plots came from multi-sampled polygons. This has the potential to incur a spatial bias in the sampling distribution (the optimal strategy would be to distribute samples such that they each test unique polygons over a wider area).

The AA plots with their assigned plant association, map unit, and location were entered into NHNM's Plot database (MS Access-based) and then transferred to the NPS Plot_v4_BE relational database. Example data sheets and data collection instructions can be found in Supplement 2 in Appendix E.

Analysis Methods

Initially, each AA point was classified into a plant association using the field data and following the Guadalupe Mountains NP vegetation classification and dichotomous key (Tables 4A–4L and Appendix B). AA points were then assigned to a map unit, according to the plant-association composition of the unit as reflected in the map unit descriptions (Tables 5 and 6A–6Q and Appendix C). In most cases, assignments were from either the primary or secondary components of the map units. Inclusions, even related ones, were considered errors when their estimated extent met or exceeded the minimum map unit size of 0.5 ha (assignments by plot are provided in the project database along with the associated floristic data). When errors occurred, for the construction of the error matrix (confusion matrix) mismatched sample points were assigned to either a map unit in an adjacent polygon if that made thematic sense (spatial concordance) or, if not, to the most closely related map unit with respect to sample point composition and environment based on the map unit descriptions in Appendix C.

The accuracy estimates in the AA matrix produced by LBJWC (and delivered to the VMI primary investigators as part of the final products) were not based on the template and calculations provided by Lea and Curtis (2010). In this matrix, overall accuracy had been estimated as if the AA sites were a simple random sample of the entire map, not stratified by map class, and so was biased in complex ways by the differences in sample sizes per map class and by the differences in the fraction of the map comprised by each map class. It also used an inappropriate very-large-sample approach to estimating confidence intervals around the accuracy estimates.

Therefore, the confusion matrix, a table with rows representing map classes, columns for classes actually observed on the ground at those points, and counts of AA plots with that combination of map class and field class as values in the cells, was read from the file provided by LBJWC, along with the numbers of AA sites in each map class, and the counts of those sites that were correct at Level 2, or the lumped Level 1, set of map classes. The total area and number of polygons per map class were extracted from elsewhere in this report.

From those data, accuracies and their confidence intervals were computed as appropriate for a sample draw stratified by map class (Stehman 1995; Stehman 1999). Within each Level 2 map class, the accuracy is the number of points with matching Level 2 class in the field divided by the total number of points in that map class. That accuracy is easily understood as the probability that a random point on the map in that map class has the same class in the field. The Bayesian approach to confidence intervals was used for these class-specific accuracies, as it gives reasonable results when either all or none of the points are correct, which happens with very small sample sizes.

The overall map accuracy needs to be a weighted mean of those map class-specific accuracies, weighted by the fraction of the map in each map class. This overall map accuracy has the same interpretation: the probability that a random point anywhere in the map has the matching vegetation class in the field. There are no direct ways to estimate confidence intervals about this weighted-average overall accuracy. However, random samples of simulated data can be generated with binomial probabilities driven by the individual map-class accuracies, and each random draw can generate a weighted average overall accuracy. Ten thousand such draws were generated, sorted, and the 5th and 95th percentiles were used to estimate a 90% confidence interval.

Because the accuracy assessment points were drawn as a stratified sample of Level 2 map classes, the accuracy for a Level 1 map class needs to be the weighted average of the accuracies of the Level 2 classes lumped into that Level 1 class, weighted by their relative areas. Computationally, estimating the accuracy and confidence interval about that accuracy for a lumped Level 1 class is equivalent to what was needed for the overall map accuracy for Level 2 classes. These computations were performed in R version 4.2 (R Core Team 2022) and the binom package (Dorai-Raj 2014). The revised accuracies are shown in Tables 7 and 8 (Level 1 and Level 2 respectively).

Accuracy Assessment Results

Overall map accuracy at Level 1 (approximately akin to the USNVC group level) was 79%, with 90% CI of 74–84% (Table 7). This accuracy is the probability that a random point on the map turns out to have a match between the map class and a field call at that location. Estimated accuracies for individual Level 1 map classes ranged from 0% for Western Interior Riparian Forest & Woodland (13) to 96% for Chihuahuan Creosotebush - Mixed Desert Scrub (11). The Western Interior Riparian Forest & Woodland class only had a single AA point, which turned out to be in Madrean Gray Oak - Alligator Juniper Canyon and Dry Wash Woodland (4B), a plausible riparian woodland confusion, and that map class only covers 128 acres (52 ha), less than 0.2% of the map area.

The two Level 1 classes with low accuracy and larger areas were Chihuahuan Desert Succulent Scrub (10), with estimated accuracy of 50%, and Eastern Madrean Chaparral (6), with estimated accuracy of 60%. Both of these were grossly undersampled in the AA draw. Class 10 covers 6,359 acres (2,573 ha), 8.2% of the map area, but because there were only 2 AA points in class 10, the 90% confidence interval for that accuracy ranges from < 1% to > 99%.

While there were 12 AA points in Class 6, they were split 6, 3, 1, and 2 across the Level 2 subclasses, and Class 6B, the subclass with the largest area on the map, had 0 of the 3 AA points key out in the field to any Class 6 category. Class 6 covers 17,834 acres (7,216 ha), or 22.9% of the entire map; Class 6B alone covers 7,146 acres (2,892 ha), 9.2% of the map. Note that valid confidence intervals for Class 6 cannot be estimated without several additional unjustified assumptions, as those 3 AA points in 6B were all wrong, and the other 9 points in the other subclasses were all correct. However, the Bayesian estimate for uncertainty about class 6B ranges from 0 to 33%, and the uncertainty about accuracy of class 5 with 8 AA points ranges from 50–100%, so 40–80% is a ballpark uncertainty about the 60% accuracy of class 6.

Note that the other Level 1 map classes with substantial sample sizes have accuracies 79% or higher.

In terms of the confusion matrix at Level 1, there was some confusion between the Eastern Madrean Chaparral (6) and Madrean Encinal (4), which might be due to the prevalence of evergreen oak shrubs in the former and trees in the latter that would have little spectral difference. Some misclassification occurred among forest and woodlands, particularly where ponderosa pine stands mapped as Madrean Lower Montane Pine - Oak Forest & Woodland (2) were actually Douglas-fir dominated stands of the Madrean Upper Montane Conifer - Oak Forest & Woodland (1) or sometimes Madrean Pinyon - Juniper Woodland (3).

The overall map accuracy at Level 2 was estimated as 68%, with 90% CI 59–76% (Table 8). Nineteen of the 38 map classes at this level have fewer than 10 AA points. Of the remaining 19 that were sampled with 10 or more points, only 7 exceeded 80% accuracy, and 7 had estimated accuracies below 60%.

As in most thematic mapping, most misclassifications occurred within their respective Level 1 groupings or closely related units (outline boxes in Table 8). For example, the same ponderosa pine to Douglas fir forest misclassification that affects the Level 1 accuracy impacted the Level 2 accuracy in the same way. Several points mapped as Viscid Acacia Desert Scrub (11A) were actually included in Creosotebush Desert Scrub (11C) or Mariola - Goldeneye - Ocotillo Desert Scrub (10A). This suggests that Creosotebush Desert Scrub may be under-mapped due to weak differential signatures among the other included units. Lastly, Grama Grass Piedmont Grassland (7H) cross-classified with Catclaw Mimosa / Sideoats Grama Semi-Desert Grassland (7J). Accordingly, we are recommending that Mimosa Desert Scrub be re-classified as Foothill-Piedmont Desert Grassland in the USNVC (USNVC.org)

because of its high overall grass cover and marginal shrub cover. One important Level 2 confusion between different Level 1 groups was noted above. The confusion between Level 1 classes 6 and 4 is entirely due to all 3 AA points mapped in Pungent Oak - Wavyleaf Oak Shrubland (6B) turning out to be Madrean Gray Oak - Alligator Juniper Canyon and Dry Wash Woodland (4B) in the field.

While these estimated Level 2 accuracies do not reach the target for NPS Vegetation Inventory maps, there is no obvious benefit to lumping these Level 2 map classes in ways other than the Level 1 classes corresponding to USNVC group level. These classes, used with reference to the confusion matrix, may well be suitable for some uses. And, when map classes are not accurate enough for a use, fieldwork to clarify the classes of interest will be based on these map classes.

Accuracy Assessment Discussion

In summary, overall accuracy at Level 1 was very close to the VMI program goal of 80%, but lower at Level 2, with overall accuracy of just 68%. The main sources of error discovered during the accuracy assessment process were primarily due to thematic content of the units and the associated limits of the image interpretation among closely related vegetation types (fundamental error). Because AA points were buffered away from the polygon boundaries to ensure that then-current GPS accuracies would position points in the right polygons, positional accuracy of the linework at scales of tens of meters is largely excluded from this accuracy estimation.

Note that the small sample sizes not only produce broad confidence intervals for the accuracy of individual map classes, they make rates of confusion between map classes even more uncertain. Even the guidance sample sizes of 25–30 points per map class are inadequate for estimating confusion rates. And, the stratification by map class is necessary to maximize the map class specific estimates, but it precludes reasonable estimates of "Producer's Accuracy" (the probability that a point in the field with vegetation class X is also mapped as class X) and adjusted estimates of area per class.

Table 7. Accuracy assessment contingency table for the Guadalupe Mountains NP vegetation map at Level 1. We provide the Users' accuracies with 10% confidence intervals where AA sites = number of sampling points per class used to calculate "% Correct" by map class. See Table 5 for map unit names associated with the map unit numbers.

Mapped As	Map Unit Name	Validated As													AA Sites	Map Class Accuracy	90% CI-	90% CI+
		1	2	3	4	5	6	7	8	9	10	11	12	13				
1	Madrean Upper Montane Conifer - Oak Forest & Woodland	36	2	–	1	–	–	–	–	–	–	–	–	–	39	0.91	0.83	0.98
2	Madrean Lower Montane Pine - Oak Forest & Woodland	7	28	2	–	–	–	–	–	–	–	–	–	–	37	0.79	0.69	0.88
3	Madrean Pinyon - Juniper Woodland	–	3	20	–	–	–	1	–	–	–	–	–	–	24	0.85	0.69	0.97
4	Madrean Encinal	–	–	–	32	–	5	–	–	–	–	–	–	–	37	0.79	0.66	0.92
5	Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland	–	–	–	–	7	1	–	–	–	–	–	–	–	8	0.75	0.50	1.00
6	Eastern Madrean Chaparral	–	–	–	3	–	9	–	–	–	–	–	–	–	12	0.60	0.60	0.60
7	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland	–	–	–	–	–	1	56	–	–	1	2	–	–	60	0.86	0.74	0.96
8	Chihuahuan Gypsophilous Grassland	–	–	–	–	–	–	–	31	5	–	1	–	–	37	0.84	0.71	0.95
9	Chihuahuan Gypsophilous Scrub	–	–	–	–	–	–	–	–	17	–	2	–	–	19	0.87	0.74	1.00
10	Chihuahuan Desert Succulent Scrub	–	–	–	–	–	–	–	–	–	1	1	–	–	2	0.50	0.00	1.00
11	Chihuahuan Creosotebush - Mixed Desert Scrub	–	–	–	–	–	–	1	–	1	2	40	–	–	44	0.96	0.91	0.99
12	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope	–	–	–	–	–	–	1	–	–	–	1	19	–	21	0.84	0.69	1.00
13	Western Interior Riparian Forest & Woodland	–	–	–	1	–	–	–	–	–	–	–	–	0	1	0.00	0.00	0.65
User's Total	n/a	43	33	22	37	7	16	59	31	23	4	47	19	0	341	n/a	n/a	n/a
Overall Accuracy	n/a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.79	0.74	0.84

Table 8. Accuracy assessment contingency table for the Guadalupe Mountains NP vegetation map at Level 2. We provide the Users' accuracies with 10% confidence intervals where AA Sites = number of sampling points per class used to calculate "% Correct" by map class. See Table 5 for map unit names associated with the map unit numbers AA Level 2.

	Validated As																																			AA Sites	Map Class Accuracy	90% CI-	90% CI+
Mapped As	**1A**	**1B**	**1C**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**5A**	**6A**	**6B**	**6C**	**6D**	**7B**	**7C**	**7D**	**7E**	**7F**	**7G**	**7H**	**7I**	**7J**	**8A**	**8B**	**8C**	**9A**	**9B**	**10A**	**11A**	**11B**	**11C**	**11D**	**11E**	**12B**	**12C**	**13A**				
1A	18	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19	0.95	0.85	1.00
1B	3	3	3	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	0.30	0.10	0.53
1C	1	1	7	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	0.70	0.47	0.90
2A	7	–	–	20	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29	0.69	0.55	0.82
2B	–	–	–	–	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	1.00	0.85	1.00
3A	–	–	–	1	1	8	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	0.67	0.45	0.86
3B	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	0.25	0.01	0.57
3C	–	–	–	1	–	–	–	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	0.88	0.67	1.00
4A	–	–	–	–	–	–	–	–	18	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	22	0.82	0.68	0.94
4B	–	–	–	–	–	–	–	–	–	10	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	0.67	0.47	0.85
5A	1	–	–	–	–	–	–	–	–	–	6	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	0.75	0.51	0.95
6A	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1.00	0.81	1.00
6B	–	–	–	–	–	–	–	–	–	3	–	–	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	0.00	0.00	0.34
6C	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1.00	0.35	1.00
6D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1.00	0.55	1.00
7B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0.50	0.10	0.90
7C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	0.90	0.72	1.00
7D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	0.82	0.62	0.97
7E	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	9	0.78	0.55	0.96
7F	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	–
7G	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	7	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	0.70	0.47	0.90
7H	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	6	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	13	0.46	0.25	0.68
7I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	1	–	–	–	–	3	0.67	0.30	0.98
7J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	3	0.67	0.30	0.98
8A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	4	–	–	–	–	–	–	–	–	–	–	10	0.60	0.36	0.83
8B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	4	–	–	–	–	–	–	–	–	15	0.73	0.55	0.90
8C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	9	–	1	–	–	–	1	–	–	–	–	12	0.75	0.55	0.92
9A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	–	–	–	–	–	–	8	1.00	0.85	1.00
9B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	–	2	–	–	–	11	0.82	0.62	0.97
10A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	2	0.50	0.10	0.90
11A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	3	–	4	–	–	–	–	9	0.33	0.11	0.58
11B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	3	–	–	–	–	–	4	0.75	0.43	0.99
11C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	–	–	–	–	15	1.00	0.92	1.00
11D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4	1.00	0.73	1.00
11E	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	10	–	–	11	0.91	0.75	1.00
12B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	3	11	0.73	0.51	0.91
12C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	3	5	10	0.50	0.26	0.74
13A	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	1	0.00	0.00	0.65
Column Total	30	4	10	24	9	10	1	11	19	18	6	13	0	2	2	1	9	10	12	2	7	8	2	7	7	11	13	8	15	4	3	3	24	5	12	11	8	0	341	n/a	n/a	n/a
Overall Accuracy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.68	0.59	0.76

Chapter 5: Summary

Outcomes from this project provide the most detailed vegetation classification and highest resolution mapping for Guadalupe Mountains NP to date. We expect the content will find various uses in fire, recreation, overall vegetation, and wildlife management. The upper Level 1 map is particularly suited to landscape scale, park-wide planning and linkages to its sister park, Carlsbad Caverns NP. The Level 2 map provides added detail for use at a more localized, project scale. The overall accuracy of the maps was good, but with Guadalupe Mountains NP as a primarily wilderness park, there were logistical challenges to map development and testing in remote areas that should be considered in planning management actions. In this context, some map units would benefit from further development and accuracy assessment. In particular, we recommend a higher resolution mapping of McKittrick Creek at 1:6,000 scale or finer, development of a structural canopy model as LiDAR becomes available that can be imputed into this map to refine desert shrubland versus grassland classes to support vegetation management, and the addition of canopy cover as component for woodlands and forests to support fire management. With respect to understanding vegetation dynamics in this time of rapid environmental change, the 540 vegetation plots themselves are sufficiently georeferenced and have the data resolution to be useful in detecting change at the decadal scales across much of the park's landscape. To this end, we would recommend installing more plots for this purpose to fill the gaps among the main vegetation units of the park, both spatially and thematically. Overall, the project will not only lend support to the park's management efforts, but to our regional understanding of vegetation and ecology of ecosystems of the southwestern United States.

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Appendix A. Guadalupe Mountains National Park Vegetation Classification and Map: Plant Species List

This appendix contains a list of plant species recorded on vegetation plots at Guadalupe Mountains National Park as part of the vegetation mapping project. Plant voucher specimens were collected to confirm field identifications as necessary and are housed at the University of New Mexico Herbarium. Specimens were identified by NHNM botanist Yvonne Chauvin to lowest level possible given the material at hand and names assigned according to the PLANTS database (USDA NRCS 2013) and the Integrated Taxonomic Information System (ITIS 2020). When those databases differed, we used the more recently updated one. Suitable quality specimens were accessioned with both UNM accession numbers and NPS record numbers (last column) tied to the Herbarium and NPS databases. Table A1 provides the list ordered by lifeform code (LFC) and scientific name; Table A2 is ordered by lifeform and common name. NHNM Acronym refers to the Natural Heritage New Mexico database code for the species; PLANTS symbol is database code from the USDA PLANTS database. Whether a voucher collection was made for the species is indicated in the Vouchered column.

Table A1. Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
1	*Acer grandidentatum*	bigtooth maple	Aceraceae	ACGR3	ACEGRA	Y	–
1	*Arbutus xalapensis*	Texas madrone	Ericaceae	ARXA80	ARBXAL	Y	–
1	*Celtis laevigata* var. *reticulata*	netleaf hackberry	Ulmaceae	CELAR	CELLAE	–	–
1	*Celtis pallida*	granjeno desert hackberry	Ulmaceae	CEPA8	CELPAL	–	–
1	*Elaeagnus angustifolia*	Russian olive	Elaeagnaceae	ELAN	ELAANG	–	–
1	*Fraxinus velutina*	velvet ash	Oleaceae	FRVE2	FRAVEL	Y	–
1	*Juglans microcarpa*	little walnut	Juglandaceae	JUMI	JUGMIC	–	–
1	*Juniperus deppeana*	alligator juniper	Cupressaceae	JUDE2	JUNDEP	–	–
1	*Juniperus monosperma*	oneseed juniper	Cupressaceae	JUMO	JUNMON	Y	–
1	*Juniperus pinchotii*	Pinchot's juniper	Cupressaceae	JUPI	JUNPIN	Y	–
1	*Juniperus scopulorum*	Rocky Mountain juniper	Cupressaceae	JUSC2	JUNSCO	Y	–
1	*Juniperus* spp.	juniper	Cupressaceae	JUNIP	JUNIPE	–	–
1	*Ostrya knowltonii*	Knowlton's hophornbeam	Betulaceae	OSKN	OSTKNO	Y	–
1	*Pinus edulis*	pinyon pine	Pinaceae	PIED	PINEDU	Y	–
1	*Pinus ponderosa*	ponderosa pine	Pinaceae	PIPO	PINPON	–	–
1	*Pinus strobiformis*	Southwestern white pine	Pinaceae	PIST3	PINSTR	–	–
1	*Populus deltoides* ssp. *wislizeni*	Rio Grande cottonwood	Salicaceae	PODEW	POPDEL	Y	–
1	*Populus tremuloides*	quaking aspen	Salicaceae	POTR5	POPTRE	–	–
1	*Pseudotsuga menziesii*	Douglas-fir	Pinaceae	PSME	PSEMEN	–	–
1	*Quercus gambelii*	Gambel oak	Fagaceae	QUGA	QUEGAM	–	–
1	*Quercus grisea*	gray oak	Fagaceae	QUGR3	QUEGRI	Y	–
1	*Quercus muehlenbergii*	chinkapin oak	Fagaceae	QUMU	QUEMUE	Y	–
2	*Acacia constricta*	whitethorn acacia	Fabaceae	ACCO2	ACACON	Y	–
2	*Acacia neovernicosa*	viscid acacia	Fabaceae	ACNE4	ACANEO	Y	–
2	*Allenrolfea occidentalis*	iodinebush	Chenopodiaceae	ALOC2	ALLOCC		–
2	*Aloysia wrightii*	Wright's beebrush	Verbenaceae	ALWR	ALOWRI	Y	–
2	*Amelanchier utahensis*	Utah serviceberry	Rosaceae	AMUT	AMEUTA	Y	–
2	*Atriplex canescens*	fourwing saltbush	Chenopodiaceae	ATCA2	ATRCAN	–	–
2	*Baccharis pteronioides*	yerba de pasmo	Asteraceae	BAPT	BACPTE	Y	GUMO-16580

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
2	*Baccharis salicina*	false willow	Asteraceae	BASA	BACSAL2	Y	–
2	*Berberis fendleri*	Colorado barberry	Berberidaceae	BEFE	BERFEN	–	–
2	*Brickellia californica*	California brickellbush	Asteraceae	BRCA3	BRICAL	Y	–
2	*Brickellia laciniata*	splitleaf brickellbush	Asteraceae	BRLA	BRILAC	–	–
2	*Brickellia* spp.	brickellbush	Asteraceae	BRICK	BRICKE	–	–
2	*Ceanothus greggii*	desert ceanothus	Rhamnaceae	CEGR	CEAGRE	Y	–
2	*Cercocarpus montanus*	mountain mahogany	Rosaceae	CEMO2	CERMON	–	–
2	*Cercocarpus montanus* var. *argenteus*	silver mountain mahogany	Rosaceae	CEMOA	CERMON	Y	–
2	*Cercocarpus montanus* var. *paucidentatus*	shaggy mountain mahogany	Rosaceae	CEMOP	CERMON	Y	–
2	*Chilopsis linearis*	desert willow	Bignoniaceae	CHLI2	CHILIN	–	–
2	*Choisya dumosa*	Mexican orange	Rutaceae	CHDU	CHODUM	Y	–
2	*Clematis pitcheri*	bluebill	Ranunculaceae	CLPI	CLEPIT	–	–
2	*Clematis pitcheri* var. *dictyota*	bluebill	Ranunculaceae	CLPID	CLEPIT	Y	–
2	*Condalia ericoides*	javelina bush	Rhamnaceae	COER5	CONERI	Y	–
2	*Condalia warnockii*	Warnock's snakewood	Rhamnaceae	COWA	CONWAR	Y	–
2	*Croton fruticulosus*	bush croton	Euphorbiaceae	CRFR	CROFRU	Y	–
2	*Cylindropuntia imbricata*	tree cholla	Cactaceae	CYIM2	CLYIMB	–	–
2	*Cylindropuntia leptocaulis*	Christmas cactus	Cactaceae	CYLE8	CYLLEP	–	–
2	*Dasylirion leiophyllum*	green sotol	Agavaceae	DALE2	DASLEI	–	–
2	*Ephedra aspera*	rough jointfir	Ephedraceae	EPAS	EPHASP	Y	–
2	*Ephedra torreyana*	Torrey's jointfir	Ephedraceae	EPTO	EPHTOR	Y	–
2	*Ephedra trifurca*	longleaf jointfir	Ephedraceae	EPTR	EPHTRI	–	–
2	*Ericameria nauseosa*	rubber rabbitbrush	Asteraceae	ERNA10	ERINAU	–	–
2	*Ericameria nauseosus* var. *texensis*	rubber rabbitbrush	Asteraceae	ERNAT2	ERINAU	Y	–
2	*Fallugia paradoxa*	Apacheplume	Rosaceae	FAPA	FALPAR	–	–
2	*Fendlera rupicola*	cliff fendlerbrush	Hydrangeaceae	FERU	FENRUP	Y	–
2	*Fendlerella utahensis*	Utah fendlerbush	Hydrangeaceae	FEUT	FENUTA	Y	–
2	*Flourensia cernua*	tarbush	Asteraceae	FLCE	FLOCER	–	–
2	*Forestiera pubescens* var. *pubescens*	New Mexico olive	Oleaceae	FOPUP	FORPUB	–	–
2	*Fouquieria splendens*	ocotillo	Fouquieriaceae	FOSP2	FOUSPL	–	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
2	*Frangula betulifolia*	birchleaf buckthorn	Rhamnaceae	FRBE2	FRABET	Y	–
2	*Frangula betulifolia* ssp. *obovata*	obovate buckthorn	Rhamnaceae	FRBEO	FRABET	Y	–
2	*Garrya ovata*	eggleaf silktassel	Garryaceae	GAOV	GAROVA	–	–
2	*Garrya ovata* ssp. *goldmanii*	Goldman's silktassel	Garryaceae	GAOVG	GAROVAG	Y	–
2	*Glossopetalon spinescens*	spiny greasebush	Crossosomataceae	GLSP	GLOSPI	–	–
2	*Glossopetalon spinescens* var. *spinescens*	spiny greasebush	Crossosomataceae	GLSPS	GLOSPI	Y	–
2	*Holodiscus dumosus*	rockspirea	Rosaceae	HODU	HOLDUM	Y	–
2	*Krascheninnikovia lanata*	winterfat	Chenopodiaceae	KRLA2	KRALAN2	–	–
2	*Larrea tridentata*	creosotebush	Zygophyllaceae	LATR2	LARTRI	–	–
2	*Leucophyllum minus*	Big Bend silver-leaf	Scrophulariaceae	LEMI4	LEUMIN	Y	–
2	*Lonicera albiflora*	western white honeysuckle	Caprifoliaceae	LOAL	LONALB	Y	–
2	*Lonicera arizonica*	Arizona honeysuckle	Caprifoliaceae	LOAR	LONARI	Y	–
2	*Lonicera* spp.	honeysuckle	Caprifoliaceae	LONIC	LONICE	–	–
2	*Lorandersonia pulchella*	southwestern rabbitbrush	Asteraceae	CHPU4	LORPUL	Y	GUMO-16581
2	*Lorandersonia spathulata*	Guadalupe rabbitbrush	Asteraceae	CHSP3	LORSPA	Y	–
2	*Lorandersonia* spp.	rabbitbrush	Asteraceae	CHRYS9	LORAND	–	–
2	*Lycium berlandieri*	Berlandier's wolfberry	Solanaceae	LYBE	LYCBER	Y	–
2	*Lycium berlandieri* var. *parviflorum*	Berlandier's wolfberry	Solanaceae	LYBEP	LYCBER	Y	–
2	*Mahonia haematocarpa*	red barberry	Berberidaceae	MAHA4	MAHHAE	Y	–
2	*Mahonia trifoliolata*	algerita	Berberidaceae	MATR3	MAHTRI	Y	–
2	*Mimosa aculeaticarpa* var. *biuncifera*	catclaw mimosa	Fabaceae	MIACB	MIMACU	–	–
2	*Mimosa borealis*	fragrant mimosa	Fabaceae	MIBO2	MIMBOR	Y	–
2	*Mortonia scabrella*	Rio Grande saddlebush	Celastraceae	MOSC	MORSCA	Y	–
2	*Morus microphylla*	Texas mulberry	Moraceae	MOMI	MORMIC	Y	–
2	*Nolina texana*	Texas sacahuista	Agavaceae	NOTE	NOLTEX	Y	GUMO-16643
2	*Opuntia engelmannii*	cactus apple	Cactaceae	OPEN3	OPUENG	Y	–
2	*Parthenocissus vitacea*	thicket creeper	Vitaceae	PAVI5	PARVIT	Y	GUMO-16642
2	*Philadelphus microphyllus*	littleleaf mockorange	Hydrangeaceae	PHMI4	PHIMIC	Y	–
2	*Physocarpus monogynus*	mountain ninebark	Rosaceae	PHMO4	PHYMON	Y	GUMO-16635
2	*Poliomintha incana*	frosted mint	Lamiaceae	POIN3	POLINC	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
2	*Porophyllum scoparium*	Trans-Pecos poreleaf	Asteraceae	POSC6	PORSCO	Y	GUMO-16582
2	*Prosopis glandulosa*	honey mesquite	Fabaceae	PRGL2	PROGLA	–	–
2	*Prunus serotina*	black cherry	Rosaceae	PRSE2	PRUSER	–	–
2	*Prunus serotina* var. *virens*	southwestern chokecherry	Rosaceae	PRSEV	PRUSER	Y	GUMO-16648
2	*Psorothamnus scoparius*	broom dalea	Fabaceae	PSSC6	PSOSCO	Y	–
2	*Ptelea trifoliata*	common hoptree	Rutaceae	PTTR	PTETRI	Y	–
2	*Quercus* × *pauciloba*	wavyleaf oak	Fagaceae	QUPA4	QUEPAU	Y	GUMO-16602
2	*Quercus pungens*	pungent oak	Fagaceae	QUPU	QUEPUN	Y	–
2	*Quercus* spp.	oak	Fagaceae	QUERC	QUERCU	–	–
2	*Rhus lanceolata*	prairie sumac	Anacardiaceae	RHLA3	RHULAN	Y	–
2	*Rhus microphylla*	littleleaf sumac	Anacardiaceae	RHMI3	RHUMIC	Y	–
2	*Rhus trilobata*	skunkbush sumac	Anacardiaceae	RHTR	RHUTRI	Y	–
2	*Rhus virens*	evergreen sumac	Anacardiaceae	RHVI3	RHUVIR	–	–
2	*Rhus virens* var. *choriophylla*	evergreen sumac	Anacardiaceae	RHVIC	RHUVIR	–	–
2	*Rhus virens* var. *virens*	evergreen sumac	Anacardiaceae	RHVIV	RHUVIR	Y	–
2	*Ribes mescalarium*	Mescalero currant	Grossulariaceae	RIME2	RIBMES	Y	–
2	*Ribes* spp.	currant; gooseberry	Grossulariaceae	RIBES	RIBES	–	–
2	*Robinia neomexicana*	New Mexico locust	Fabaceae	RONE	ROBNEO	–	–
2	*Rosa stellata*	desert rose	Rosaceae	ROST	ROSSTE	–	–
2	*Rosa stellata* ssp. *mirifica* var. *erlansoniae*	desert rose	Rosaceae	ROSTE2	ROSSTE	Y	–
2	*Rosa woodsii*	Woods' rose	Rosaceae	ROWO	ROSWOO	Y	–
2	*Sophora secundiflora*	mescal bean	Fabaceae	SOSE3	SOPSEC	–	–
2	*Symphoricarpos longiflorus*	desert snowberry	Caprifoliaceae	SYLO	SYMLON	Y	–
2	*Symphoricarpos oreophilus*	whortleleaf snowberry	Caprifoliaceae	SYOR2	SYMORE	Y	–
2	*Symphoricarpos palmeri*	Palmer's snowberry	Caprifoliaceae	SYPA	SYMPAL	Y	GUMO-16649
2	*Symphoricarpos* spp.	snowberry	Caprifoliaceae	SYMPH	SYMPHO	Y	–
2	*Ungnadia speciosa*	Mexican buckeye	Sapindaceae	UNSP	UNGSPE	–	–
2	unidentified shrub	unidentified shrub	unknown	2SHRUB	UNIDS	–	–
2	*Viguiera stenoloba*	skeletonleaf goldeneye	Asteraceae	VIST	VIGSTE	–	–
2	*Vitis arizonica*	canyon grape	Vitaceae	VIAR2	VITARI	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
2	*Yucca baccata*	banana yucca	Agavaceae	YUBA	YUCBAC	–	–
2	*Yucca elata*	soaptree yucca	Agavaceae	YUEL	YUCELA	–	–
2	*Yucca faxoniana*	giant dagger	Agavaceae	YUFA	YUCFAX	–	–
2	*Yucca torreyi*	Torrey's yucca	Agavaceae	YUTO	YUCTOR	Y	–
2	*Ziziphus obtusifolia*	lotebush	Rhamnaceae	ZIOB	ZIZOBT	–	–
2.5	*Acacia angustissima*	prairie acacia	Fabaceae	ACAN	ACAANG	Y	–
2.5	Agavaceae	agave family	Agavaceae	AGAVAC	AGAVAC	Y	–
2.5	*Agave gracilipes*	slimfoot century plant	Agavaceae	AGGR4	AGAGRA	Y	–
2.5	*Agave lechuguilla*	lechuguilla	Agavaceae	AGLE	AGALEC	–	–
2.5	*Agave parryi*	Parry's agave	Agavaceae	AGPA4	AGAPAR	–	–
2.5	*Agave parryi* ssp. *neomexicana*	Parry's agave	Agavaceae	AGPAN6	AGAPAR	Y	–
2.5	*Ageratina herbacea*	fragrant snakeroot	Asteraceae	AGHE5	AGEHER	Y	GUMO-16578
2.5	*Ageratina wrightii*	Wright's snakeroot	Asteraceae	AGWR2	AGEWRI	Y	GUMO-16579
2.5	*Arceuthobium douglasii*	Douglas fir dwarf mistletoe	Viscaceae	ARDO	ARCDOU	Y	–
2.5	*Ayenia microphylla*	dense ayenia	Sterculiaceae	AYMI	AYENIA	Y	–
2.5	*Baccharis havardii*	Havard's false willow	Asteraceae	BAHA2	BACHAV	Y	–
2.5	*Baccharis wrightii*	Wright's baccharis	Asteraceae	BAWR	BACWRI	–	–
2.5	*Brickellia eupatorioides* var. *chlorolepis*	false boneset	Asteraceae	BREUC2	BRIEUP	Y	–
2.5	*Brickellia grandiflora*	tasselflower brickellbush	Asteraceae	BRGR	BRIGRA	Y	–
2.5	*Chrysactinia mexicana*	damiantia	Asteraceae	CHME3	CHRMEX	Y	–
2.5	*Dalea bicolor* var. *argyraea*	silver prairieclover	Fabaceae	DABIA	DALBICA	Y	–
2.5	*Dalea formosa*	featherplume	Fabaceae	DAFO	DALFOR	Y	–
2.5	*Dalea frutescens*	black prairieclover	Fabaceae	DAFR2	DALFRU	Y	–
2.5	*Desmanthus cooleyi*	Cooley's bundleflower	Fabaceae	DECO2	DESCOO	–	–
2.5	*Echinocactus horizonthalonius*	devilshead	Cactaceae	ECHO	ECHHOR	Y	–
2.5	*Echinocactus* spp.	echinocactus	Cactaceae	ECHIN2	ECHINO	–	–
2.5	*Echinocereus coccineus*	scarlet hedgehog cactus	Cactaceae	ECCO5	ECHCOC	–	–
2.5	*Echinocereus dasyacanthus*	rainbow cactus	Cactaceae	ECDA	ECHDAS	Y	–
2.5	*Echinocereus enneacanthus*	pitaya	Cactaceae	ECEN2	ECHENN	Y	–
2.5	*Echinocereus pectinatus*	rainbow cactus	Cactaceae	ECPE	ECHPEC	–	–

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2.5	*Echinocereus* spp.	hedgehog cactus	Cactaceae	ECHIN3	ECHINO2	–	–
2.5	*Echinocereus stramineus*	strawberry hedgehog cactus	Cactaceae	ECST2	ECHSTR	Y	–
2.5	*Echinocereus triglochidiatus*	kingcup cactus	Cactaceae	ECTR	ECHTRI	Y	–
2.5	*Echinocereus viridiflorus*	nylon hedgehog cactus	Cactaceae	ECVI2	ECHVIR	Y	–
2.5	*Echinocereus viridiflorus* var. *chloranthus*	brownspine hedgehog cactus	Cactaceae	ECVIC6	ECHVIR	–	–
2.5	*Echinomastus intertextus*	white fishhook cactus	Cactaceae	ECIN2	ECHINT	Y	–
2.5	*Epithelantha micromeris*	pingpong ball cactus	Cactaceae	EPMI2	EPIMIC	Y	–
2.5	*Eriogonum wrightii*	Wright's buckwheat	Polygonaceae	ERWR	ERIWRI	Y	–
2.5	*Escobaria* spp.	beehive cactus	Cactaceae	ESCOB	ESCOBA	–	–
2.5	*Escobaria tuberculosa*	whitecolumn foxtail cactus	Cactaceae	ESTU	ESCTUB	Y	–
2.5	*Escobaria vivipara*	spinystar	Cactaceae	ESVI2	ESCVIV	–	–
2.5	*Grusonia grahamii*	Graham's club-cholla	Cactaceae	GRGR6	GRUGRA	–	–
2.5	*Gutierrezia sarothrae*	broom snakeweed	Asteraceae	GUSA2	GUTSAR	Y	–
2.5	*Gymnosperma glutinosum*	gumhead	Asteraceae	GYGL	GYMGLU	Y	–
2.5	*Hibiscus denudatus*	paleface	Malvaceae	HIDE	HIBDEN	Y	–
2.5	*Isocoma pluriflora*	southern jimmyweed	Asteraceae	ISPL	ISOPLU	Y	–
2.5	*Justicia warnockii*	Warnock's water-willow	Acanthaceae	JUWA	JUSWAR	Y	GUMO-16576
2.5	*Krameria grayi*	white ratany	Krameriaceae	KRGR	KRAGRA	Y	–
2.5	*Mahonia repens*	Oregongrape	Berberidaceae	MARE11	MAHREP	Y	–
2.5	*Mammillaria meiacantha*	little nipple cactus	Cactaceae	MAME6	MAMMEI	Y	–
2.5	*Menodora longiflora*	showy menodora	Oleaceae	MELO2	MENLON	Y	–
2.5	*Menodora scabra*	rough menodora	Oleaceae	MESC	MENSCA	Y	–
2.5	*Opuntia macrocentra*	purple pricklypear	Cactaceae	OPMA8	OPUMAC	–	–
2.5	*Opuntia phaeacantha*	tulip pricklypear	Cactaceae	OPPH	OPUPHA	Y	–
2.5	*Opuntia polyacantha*	plains pricklypear	Cactaceae	OPPO	OPUPOL	–	–
2.5	*Opuntia* spp.	pricklypear	Cactaceae	OPUNT	OPUNTI	–	–
2.5	*Parthenium incanum*	mariola	Asteraceae	PAIN2	PARINC	–	–
2.5	*Petrophyton caespitosum*	mat rockspirea	Rosaceae	PECA12	PETCAE	Y	–
2.5	*Phoradendron coryae*	Cory's mistletoe	Viscaceae	PHCO14	PHOCOR	Y	–
2.5	*Salvia lycioides*	canyon sage	Lamiaceae	SALY	SALLYC	Y	–

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2.5	*Sclerocactus uncinatus* var. *wrightii*	Chihuahuan fishhook cactus	Cactaceae	SCUNW	SCLUNC	–	–
2.5	*Suaeda nigra*	bush seepweed	Chenopodiaceae	SUNI	SUANIG	Y	GUMO-16587
2.5	*Talinopsis frutescens*	arroyo flameflower	Portulacaceae	TAFR	TALFRU	Y	–
2.5	*Thymophylla acerosa*	pricklyleaf dogweed	Asteraceae	THAC	THYACE	Y	–
2.5	*Thymophylla setifolia* var. *radiata*	Texas pricklyleaf	Asteraceae	THSER	THYSET	Y	–
2.5	*Tiquilia canescens*	woody crinklemat	Boraginaceae	TICA3	TIQCAN	Y	–
2.5	*Tiquilia greggii*	plumed crinklemat	Boraginaceae	TIGR	TIQGRE	Y	–
2.5	*Tiquilia hispidissima*	hairy crinklemat	Boraginaceae	TIHI	TIQHIS	Y	–
2.5	*Tiquilia* spp.	crinklemat	Boraginaceae	TIQUI	TIQUIL	–	–
2.5	unidentified subshrub	unidentified subshrub	unknown	2SUBS	UNIDDS	–	–
3	*Achnatherum curvifolium*	Guadalupe needlegrass	Poaceae	ACCU6	ACHCUR	Y	GUMO-16650
3	*Achnatherum eminens*	southwestern needlegrass	Poaceae	ACEM4	ACHEMI	Y	–
3	*Achnatherum hymenoides*	Indian ricegrass	Poaceae	ACHY	ACHHYM	–	–
3	*Achnatherum lobatum*	little awn needlegrass	Poaceae	ACLO7	ACHLOB	Y	–
3	*Achnatherum* spp.	needlegrass	Poaceae	ACHNA	ACHNAT	–	–
3	*Andropogon gerardii*	big bluestem	Poaceae	ANGE	ANDGER	Y	–
3	*Andropogon hallii*	sand bluestem	Poaceae	ANHA	ANDHAL	Y	GUMO-16608
3	*Andropogon* spp.	bluestem	Poaceae	ANDRO2	ANDROP	–	–
3	*Aristida adscensionis*	sixweeks threeawn	Poaceae	ARAD	ARIADS	–	–
3	*Aristida divaricata*	poverty threeawn	Poaceae	ARDI5	ARIDIV	–	–
3	*Aristida pansa*	Wooton's threeawn	Poaceae	ARPA9	ARIPAN	Y	–
3	*Aristida purpurea*	purple threeawn	Poaceae	ARPU9	ARIPUR	Y	–
3	*Aristida purpurea* var. *nealleyi*	Nealley's threeawn	Poaceae	ARPUN	ARIPUR	Y	–
3	*Aristida purpurea* var. *purpurea*	purple threeawn	Poaceae	ARPUP6	ARIPUR	Y	GUMO-16609
3	*Aristida purpurea* var. *wrightii*	Wright's threeawn	Poaceae	ARPUW	ARIPUR	Y	GUMO-16646
3	*Aristida* spp.	threeawn	Poaceae	ARIST	ARISTI	–	–
3	*Aristida ternipes*	spidergrass	Poaceae	ARTE3	ARITER	–	–
3	*Blepharoneuron tricholepis*	pine dropseed	Poaceae	BLTR	BLETRI	Y	–
3	*Bothriochloa barbinodis*	cane bluestem	Poaceae	BOBA3	BOTBAR	Y	–
3	*Bothriochloa laguroides*	silver beardgrass	Poaceae	BOLA2	BOTLAG	–	–

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3	*Bothriochloa laguroides* ssp. *torreyana*	silver beardgrass	Poaceae	BOLAT	BOTLAG	Y	GUMO-16610
3	*Bouteloua aristidoides*	needle grama	Poaceae	BOAR	BOUARI	Y	GUMO-16611
3	*Bouteloua barbata*	sixweeks grama	Poaceae	BOBA2	BOUBAR	Y	–
3	*Bouteloua breviseta*	gypsum grama	Poaceae	BOBR	BOUBRE	Y	–
3	*Bouteloua curtipendula*	sideoats grama	Poaceae	BOCU	BOUCUR	Y	–
3	*Bouteloua eriopoda*	black grama	Poaceae	BOER4	BOUERI	Y	–
3	*Bouteloua gracilis*	blue grama	Poaceae	BOGR2	BOUGRA	–	–
3	*Bouteloua hirsuta*	hairy grama	Poaceae	BOHI2	BOUHIR	Y	–
3	*Bouteloua uniflora*	oneflower grama	Poaceae	BOUN	BOUUNI	Y	GUMO-16612
3	*Bouteloua warnockii*	Warnock's grama	Poaceae	BOWA	BOUWAR	Y	–
3	*Bromus ciliatus*	fringed brome	Poaceae	BRCI2	BROCIL	–	–
3	*Bromus frondosus*	weeping brome	Poaceae	BRFR2	BROFRO	Y	GUMO-16613
3	*Bromus inermis*	smooth brome	Poaceae	BRIN2	BROINE	–	–
3	*Bromus lanatipes*	woolly brome	Poaceae	BRLA6	BROLAN	Y	GUMO-16614
3	*Bromus porteri*	Porter brome	Poaceae	BRPO2	BROPOR	Y	GUMO-16615
3	*Bromus* spp.	brome	Poaceae	BROMU	BROMUS	–	–
3	*Buchloe dactyloides*	buffalograss	Poaceae	BODA2	BUCDAC	–	–
3	*Carex geophila*	White Mountain sedge	Cyperaceae	CAGE	CARGEO	–	–
3	*Carex microdonta*	littletooth sedge	Cyperaceae	CAMI5	CARMIC	Y	GUMO-16592
3	*Carex muriculata*	Schiede's sedge	Cyperaceae	CAMU8	CARMUR	Y	–
3	*Carex planostachys*	cedar sedge	Cyperaceae	CAPL3	CARPLA	Y	GUMO-16593
3	*Carex* spp. - upland small	sm. upland sedge <25 cm	Cyperaceae	CAREX	CAREX	Y	–
3	*Carex* spp. - upland tall	tall upland sedge >25 cm	Cyperaceae	CAREX	CAREX	Y	–
3	*Cladium californicum*	California sawgrass	Cyperaceae	CLCA2	CLACAL	Y	–
3	*Cynodon dactylon*	bermudagrass	Poaceae	CYDA	CYNDAC	–	–
3	*Cyperus fendlerianus*	Fendler's flatsedge	Cyperaceae	CYFE2	CYPFEN	Y	GUMO-16594
3	*Cyperus sphaerolepis*	Rusby's flatsedge	Cyperaceae	CYSP7	CYPSPH	Y	GUMO-16595
3	*Cyperus* spp.	flatsedge	Cyperaceae	CYPER	CYPERU	–	–
3	*Dasyochloa pulchella*	fluffgrass	Poaceae	DAPU7	DASPUL	Y	GUMO-16616
3	*Dichanthelium oligosanthes* var. *scribnerianum*	Scribner's rosette grass	Poaceae	DIOLS	DICOLI	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
3	*Digitaria californica*	Arizona cottontop	Poaceae	DICA8	DIGCAL	Y	GUMO-16617
3	*Digitaria pubiflora*	western witchgrass	Poaceae	DIPU9	DIGPUB	Y	–
3	*Eleocharis rostellata*	beaked spikerush	Cyperaceae	ELRO2	ELEROS	Y	–
3	*Elymus arizonicus*	Arizona wheatgrass	Poaceae	ELAR7	ELYARI	Y	–
3	*Elymus canadensis*	Canada wildrye	Poaceae	ELCA4	ELYCAN	–	–
3	*Elymus elymoides*	bottlebrush squirreltail	Poaceae	ELEL5	ELYELY	Y	–
3	*Elymus* spp.	wildrye	Poaceae	ELYMU	ELYMUS	–	–
3	*Enneapogon desvauxii*	nineawn pappusgrass	Poaceae	ENDE	ENNDES	Y	–
3	*Eragrostis cilianensis*	stinkgrass	Poaceae	ERCI	ERACIL	Y	GUMO-16618
3	*Eragrostis intermedia*	plains lovegrass	Poaceae	ERIN	ERAINT	Y	–
3	*Eragrostis lehmanniana*	Lehmann's lovegrass	Poaceae	ERLE	ERALEH	Y	GUMO-16619
3	*Eragrostis* spp.	lovegrass	Poaceae	ERAGR	ERAGRO	–	–
3	*Erioneuron avenaceum*	shortleaf woollygrass	Poaceae	ERAV	ERIAVE	Y	–
3	*Erioneuron pilosum*	hairy woollygrass	Poaceae	ERPI5	ERIPIL	Y	–
3	*Festuca arizonica*	Arizona fescue	Poaceae	FEAR2	FESARI	Y	–
3	*Festuca pratensis*	meadow fescue	Poaceae	FEPR	FESPRA	Y	–
3	*Glyceria striata*	fowl mannagrass	Poaceae	GLST	GLYSTR	Y	–
3	*Hesperostipa comata*	needle-and-thread grass	Poaceae	HECO26	HESCOM	Y	–
3	*Hesperostipa comata* ssp. *comata*	needle-and-thread grass	Poaceae	HECOC8	HESCOM	Y	GUMO-16620
3	*Hesperostipa neomexicana*	New Mexico needlegrass	Poaceae	HENE5	HESNEO	Y	–
3	*Hesperostipa* spp.	needle and thread	Poaceae	HESPE11	HESPER	Y	–
3	*Heteropogon contortus*	tanglehead	Poaceae	HECO10	HETCON	Y	GUMO-16621
3	*Juncus dudleyi*	slender rush	Juncaceae	JUDU2	JUNDUD	Y	–
3	*Juncus torreyi*	Torrey's rush	Juncaceae	JUTO	JUNTOR	Y	–
3	*Koeleria macrantha*	prairie junegrass	Poaceae	KOMA	KOEMAC	–	–
3	*Leptochloa dubia*	green sprangletop	Poaceae	LEDU	LEPDUB	Y	–
3	*Lycurus setosus*	bristly wolfstail	Poaceae	LYSE3	LYCSET	Y	GUMO-16647
3	*Melica nitens*	threeflower melicgrass	Poaceae	MENI	MELNIT	Y	–
3	*Muhlenbergia arenacea*	ear muhly	Poaceae	MUAR	MUHARE	–	–
3	*Muhlenbergia arenicola*	sand muhly	Poaceae	MUAR2	MUHARE2	Y	GUMO-16622

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
3	*Muhlenbergia asperifolia*	alkali muhly	Poaceae	MUAS	MUHASP	Y	–
3	*Muhlenbergia depauperata*	sixweeks muhly	Poaceae	MUDE	MUHDEP	Y	GUMO-16623
3	*Muhlenbergia dubia*	pine muhly	Poaceae	MUDU	MUHDUB	Y	GUMO-16624
3	*Muhlenbergia emersleyi*	bullgrass	Poaceae	MUEM	MUHEME	Y	–
3	*Muhlenbergia montana*	mountain muhly	Poaceae	MUMO	MUHMON	Y	GUMO-16625
3	*Muhlenbergia pauciflora*	New Mexico muhly	Poaceae	MUPA2	MUHPAU	Y	–
3	*Muhlenbergia porteri*	bush muhly	Poaceae	MUPO2	MUHPOR	Y	–
3	*Muhlenbergia repens*	creeping muhly	Poaceae	MURE	MUHFEP	–	–
3	*Muhlenbergia setifolia*	curlyleaf muhly	Poaceae	MUSE	MUHSET	Y	–
3	*Muhlenbergia* spp.	muhly	Poaceae	MUHLE	MUHLEN	–	–
3	*Muhlenbergia tenuifolia*	slimflower muhly	Poaceae	MUTE4	MUHTEN	Y	GUMO-16626
3	*Muhlenbergia wrightii*	spike muhly	Poaceae	MUWR	MUHWRI	–	–
3	*Munroa squarrosa*	false buffalograss	Poaceae	MUSQ3	MUNSQU	–	–
3	*Nassella tenuissima*	Finestem needlegrass	Poaceae	NATE3	NASTEN	Y	–
3	*Panicum bulbosum*	bulb panicgrass	Poaceae	PABU	PANBUL	Y	–
3	*Panicum hallii*	Hall's panicgrass	Poaceae	PAHA	PANHAL	Y	–
3	*Panicum obtusum*	vine mesquite	Poaceae	PAOB	PANOBT	Y	–
3	*Panicum* spp.	panicgrass	Poaceae	PANIC	PANICU	–	–
3	*Panicum virgatum*	switchgrass	Poaceae	PAVI2	PANVIR	Y	–
3	*Pascopyrum smithii*	western wheatgrass	Poaceae	PASM	PASSMI	–	–
3	*Piptatherum micranthum*	littleseed ricegrass	Poaceae	PIMI7	PIPMIC	–	–
3	*Piptochaetium fimbriatum*	pinyon ricegrass	Poaceae	PIFI	PIPFIM	Y	–
3	*Piptochaetium pringlei*	Pringle needlegrass	Poaceae	PIPR2	PIPPRI	Y	–
3	*Poa fendleriana*	muttongrass	Poaceae	POFE	POAFEN	Y	–
3	*Polypogon viridis*	beardless rabbitsfoot	Poaceae	POVI9	POLVIR	Y	–
3	*Pseudoroegneria spicata*	bluebunch wheatgrass	Poaceae	PSSP6	PSESPI	Y	GUMO-16627
3	*Schizachyrium scoparium*	little bluestem	Poaceae	SCSC	SCHSCO	Y	–
3	*Schoenoplectus americanus*	American bulrush	Cyperaceae	SCAM6	SCHAME	Y	–
3	*Scleropogon brevifolius*	burrograss	Poaceae	SCBR2	SCLBRE	–	–
3	*Setaria leucopila*	streambed bristlegrass	Poaceae	SELE6	SETLEU	Y	GUMO-16628

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
3	*Sporobolus airoides*	alkali sacaton	Poaceae	SPAI	SPOAIR	–	–
3	*Sporobolus contractus*	spike dropseed	Poaceae	SPCO4	SPOCON	–	–
3	*Sporobolus cryptandrus*	sand dropseed	Poaceae	SPCR	SPOCRY	Y	–
3	*Sporobolus flexuosus*	mesa dropseed	Poaceae	SPFL2	SPOFLE	–	–
3	*Sporobolus giganteus*	giant dropseed	Poaceae	SPGI	SPOGIG	Y	–
3	*Sporobolus nealleyi*	gyp dropseed	Poaceae	SPNE	SPONEA	Y	–
3	*Sporobolus wrightii*	big sacaton	Poaceae	SPWR2	SPOWRI	–	–
3	*Tridens muticus*	slim tridens	Poaceae	TRMU	TRIMUT	–	–
3	*Tridens muticus* var. *muticus*	slim tridens	Poaceae	TRMUM	TRIMUT	Y	–
3	unidentified graminoid	unidentified graminoid	unknown	2GRAM	UNIDG	–	–
4	*Abronia angustifolia*	purple sand verbena	Nyctaginaceae	ABAN	ABRANG	Y	–
4	*Abutilon* spp.	Indian mallow	Malvaceae	ABUTI	ABUTIL	Y	–
4	*Acalypha neomexicana*	New Mexico copperleaf	Euphorbiaceae	ACNE	ACANEO2	Y	–
4	*Acalypha phleoides*	shrubby copperleaf	Euphorbiaceae	ACPH3	ACAPHL	Y	–
4	*Achillea millefolium*	common yarrow	Asteraceae	ACMI2	ACHMIL	–	–
4	*Acleisanthes lanceolata*	gypsum moonpod	Nyctaginaceae	SELA3	SELLAN	Y	–
4	*Acleisanthes longiflora*	angel's trumpets	Nyctaginaceae	ACLO2	ACLLON	–	–
4	*Acourtia nana*	desert holly	Asteraceae	ACNA2	ACONAN	Y	–
4	*Adiantum capillus-veneris*	common maidenhair	Pteridaceae	ADCA	ADICAP	Y	–
4	*Agastache breviflora*	Trans-Pecos giant hyssop	Lamiaceae	AGBR	AGABRE	Y	–
4	*Aletes filifolius*	Trans-Pecos Indian parsley	Apiaceae	ALFI3	ALEFIL	Y	–
4	*Allionia choisyi*	annual windmills	Nyctaginaceae	ALCH	ALLCHO	–	–
4	*Allionia incarnata*	trailing windmills	Nyctaginaceae	ALIN	ALLINC	Y	–
4	*Allium cernuum*	nodding onion	Liliaceae	ALCE2	ALLCER	Y	–
4	*Allium kunthii*	Kunth's onion	Liliaceae	ALKU	ALLKUN	Y	–
4	*Allium* spp.	onion	Liliaceae	ALLIU	ALLIUM	–	–
4	*Allowissadula holosericea*	Chisos Mountain false Indianmallow	Malvaceae	ALHO4	ALLHOL	Y	–
4	*Amaranthus retroflexus*	redroot pigweed	Amaranthaceae	AMRE	AMARET	Y	–
4	*Amaranthus wrightii*	Wright's amaranth	Amaranthaceae	AMWR	AMAWRI	Y	–
4	*Ambrosia psilostachya*	Cuman ragweed	Asteraceae	AMPS	AMBPSI	–	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
4	*Antennaria marginata*	whitemargin pussytoes	Asteraceae	ANMA5	ANTMAR	Y	–
4	*Aphanostephus ramosissimus*	plains dozedaisy	Asteraceae	APRA	APHRAM	Y	–
4	Apiaceae	carrot family	Apiaceae	APIACE	APIACE	–	–
4	*Apocynum cannabinum*	Indianhemp	Apocynaceae	APCA	APOCAN	–	–
4	*Aquilegia* spp.	columbine	Ranunculaceae	AQUIL	AQUILE	–	–
4	*Argemone squarrosa*	hedgehog pricklypoppy	Papaveraceae	ARSQ	ARGSQU	Y	–
4	*Argemone squarrosa* ssp. *glabrata*	hedgehog pricklypoppy	Papaveraceae	ARSQG	ARGSQU	Y	–
4	*Argyrochosma limitanea*	southwestern falsecloak fern	Pteridaceae	ARLI4	ARGLIM	–	–
4	*Argyrochosma limitanea* ssp. *mexicana*	southwestern falsecloak fern	Pteridaceae	ARLIM	ARGLIM	Y	GUMO-16632
4	*Argyrochosma microphylla*	smallleaf falsecloak fern	Pteridaceae	ARMI6	ARGMIC	Y	–
4	*Argythamnia neomexicana*	New Mexico silverbush	Euphorbiaceae	ARNE2	ARGNEO	Y	–
4	*Artemisia dracunculus*	wild tarragon	Asteraceae	ARDR4	ARTDRA	–	–
4	*Artemisia ludoviciana*	white sagebrush	Asteraceae	ARLU	ARTLUD	Y	–
4	*Artemisia ludoviciana* ssp. *ludoviciana*	foothill sagewort	Asteraceae	ARLUL2	ARTLUD	Y	–
4	*Artemisia ludoviciana* ssp. *mexicana*	Mexican white sagebrush	Asteraceae	ARLUM2	ARTLUD	Y	–
4	*Asclepiadaceae*	milkweed family	Asclepiadaceae	ASCLEP	ASCLEP	–	–
4	*Asclepias asperula*	spider milkweed	Asclepiadaceae	ASAS	ASCASP	–	–
4	*Asclepias asperula* ssp. *asperula*	spider milkweed	Asclepiadaceae	ASASA	ASCASP	Y	GUMO-16577
4	*Asclepias latifolia*	broadleaf milkweed	Asclepiadaceae	ASLA4	ASCLAT	–	–
4	*Asclepias* spp.	milkweed	Asclepiadaceae	ASCLE	ASCLEP2	–	–
4	*Asclepias tuberosa*	butterfly milkweed	Asclepiadaceae	ASTU	ASCTUB	Y	–
4	*Asclepias tuberosa* ssp. *interior*	butterfly milkweed	Asclepiadaceae	ASTUI	ASCTUB	–	–
4	*Asplenium resiliens*	blackstem spleenwort	Aspleniaceae	ASRE	ASPRES	Y	–
4	*Aster* spp.	aster	Asteraceae	ASTER	ASTER	–	–
4	*Astragalus emoryanus*	Emory's milkvetch	Fabaceae	ASEM2	ASTEMO	Y	–
4	*Astragalus pictiformis*	Guadalupe milkvetch	Fabaceae	ASPI3	ASTPIC	Y	–
4	*Astragalus* spp.	milkvetch	Fabaceae	ASTRA	ASTRAG	–	–
4	*Astrolepis cochisensis*	Cochise scaly cloakfern	Pteridaceae	ASCO42	ASTCOC	Y	GUMO-16633
4	*Astrolepis integerrima*	hybrid cloakfern	Pteridaceae	ASIN19	ASTINT2	Y	GUMO-16634
4	*Astrolepis sinuata*	wavy scaly cloakfern	Pteridaceae	ASSI9	ASTSIN	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
4	*Bahia absinthifolia*	hairyseed bahia	Asteraceae	BAAB	BAHABS	Y	–
4	*Bahia dissecta*	ragleaf bahia	Asteraceae	BADI	BAHDIS	–	–
4	*Bahia pedata*	bluntscale bahia	Asteraceae	BAPE	BAHPED	Y	–
4	*Baileya multiradiata*	desert marigold	Asteraceae	BAMU	BAIMUL	Y	–
4	*Berlandiera lyrata*	lyreleaf greeneyes	Asteraceae	BELY	BERLYR	Y	–
4	*Bidens bigelovii*	Bigelow's beggarticks	Asteraceae	BIBI	BIDBIG	Y	–
4	*Boerhavia* spp.	spiderling	Nyctaginaceae	BOERH2	BOERHA	–	–
4	*Brassica* spp.	mustard	Brassicaceae	BRASS2	BRASSI	–	–
4	*Brickellia brachyphylla*	plumed brickellbush	Asteraceae	BRBR2	BRIBRA	Y	–
4	*Calylophus hartwegii* ssp. *pubescens*	Hartweg's sundrops	Onagraceae	CAHAP	CALHAR	Y	–
4	*Campanula rotundifolia*	bluebell bellflower	Campanulaceae	CARO2	CAMROT	Y	–
4	*Castilleja integra*	wholeleaf Indian paintbrush	Orobanchaceae	CAIN14	CASINT	Y	–
4	*Castilleja* spp.	paintbrush	Orobanchaceae	CASTI2	CASTIL	–	–
4	*Cevallia sinuata*	stinging serpent	Loasaceae	CESI	CEVSIN	Y	–
4	*Chaetopappa ericoides*	rose heath	Asteraceae	CHER2	CHAERI	Y	–
4	*Chamaesaracha coniodes*	gray five eyes	Solanaceae	CHCO	CHACON	Y	–
4	*Chamaesaracha coronopus*	greenleaf five eyes	Solanaceae	CHCO2	CHACOR	Y	–
4	*Chamaesaracha edwardsiana*	Edwards Plateau five eyes	Solanaceae	CHED	CHAMAE	Y	–
4	*Chamaesaracha sordida*	hairy five eyes	Solanaceae	CHSO	CHASOR	Y	–
4	*Chamaesaracha* spp.	five eyes	Solanaceae	CHAMA8	CHAMAE	–	–
4	*Chamaesyce acuta*	pointed sandmat	Euphorbiaceae	CHAC2	CHAACU	Y	GUMO-16596
4	*Chamaesyce chaetocalyx*	bristlecup sandmat	Euphorbiaceae	CHCH5	CHACHA	Y	GUMO-16645
4	*Chamaesyce fendleri*	Fendler's sandmat	Euphorbiaceae	CHFE3	CHAFEN	–	–
4	*Chamaesyce glyptosperma*	ribseed sandmat	Euphorbiaceae	CHGL13	CHAGLY	Y	–
4	*Chamaesyce lata*	hoary sandmat	Euphorbiaceae	CHLA10	CHALAT	Y	–
4	*Chamaesyce parryi*	Parry's sandmat	Euphorbiaceae	CHPA28	CHAPAR	Y	–
4	*Chamaesyce revoluta*	threadstem sandmat	Euphorbiaceae	CHRE4	CHAREV	Y	–
4	*Chamaesyce serpens*	matted sandmat	Euphorbiaceae	CHSE4	CHASER	–	–
4	*Chamaesyce serpyllifolia*	thymeleaf sandmat	Euphorbiaceae	CHSE6	CHASER2	Y	–
4	*Chamaesyce serrula*	sawtooth sandmat	Euphorbiaceae	CHSE7	CHASER3	Y	GUMO-16597

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

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4	*Chamaesyce* spp.	sandmat	Euphorbiaceae	CHAMA15	CHAMAE2	–	–
4	*Chamaesyce stictospora*	slimseed sandmat	Euphorbiaceae	CHST8	CHASTI	Y	GUMO-16598
4	*Cheilanthes eatonii*	Eaton's lipfern	Pteridaceae	CHEA	CHEEAT	Y	–
4	*Cheilanthes feei*	slender lipfern	Pteridaceae	CHFE	CHEFEE	Y	–
4	*Cheilanthes villosa*	villous lipfern	Pteridaceae	CHVI	CHEVIL	Y	–
4	*Chenopodium graveolens*	fetid goosefoot	Chenopodiaceae	CHGR2	CHEGRA	Y	GUMO-16586
4	*Chenopodium incanum*	mealy goosefoot	Chenopodiaceae	CHIN2	CHEINC	Y	–
4	*Chenopodium leptophyllum*	narrowleaf goosefoot	Chenopodiaceae	CHLE4	CHELEP	Y	–
4	*Cirsium* spp.	thistle	Asteraceae	CIRSI	CIRSIU	–	–
4	*Cirsium undulatum*	wavyleaf thistle	Asteraceae	CIUN	CIRUND	Y	–
4	*Cologania angustifolia*	longleaf cologania	Fabaceae	COAN	COLANG	Y	–
4	*Cologania pallida*	pale cologania	Fabaceae	COPA4	COLPAL	Y	–
4	*Commelina dianthifolia*	birdbill dayflower	Commelinaceae	CODI4	COMDIA	Y	GUMO-16644
4	*Commelina erecta*	whitemouth dayflower	Commelinaceae	COER	COMERE	Y	–
4	*Conopholis alpina* var. *mexicana*	Mexican cancer-root	Orobanchaceae	COALM	CONALP	Y	–
4	*Convolvulus arvensis*	field bindweed	Convolvulaceae	COAR4	CONARV	Y	GUMO-16588
4	*Convolvulus equitans*	Texas bindweed	Convolvulaceae	COEQ	CONEQU	Y	–
4	*Conyza canadensis*	Canadian horseweed	Asteraceae	COCA5	CONCAN	Y	–
4	*Corallorhiza maculata*	summer coralroot	Orchidaceae	COMA25	CORMAC	–	–
4	*Croton dioicus*	grassland croton	Euphorbiaceae	CRDI6	CRODIO	Y	–
4	*Croton lindheimerianus*	threeseed croton	Euphorbiaceae	CRLI2	CROLIN	Y	–
4	*Croton pottsii*	leatherweed	Euphorbiaceae	CRPO5	CROPOT	Y	–
4	*Croton* spp.	croton	Euphorbiaceae	CROTO	CROTON	–	–
4	*Cryptantha crassisepala*	hiddenflower	Boraginaceae	CRCR3	CRYCRA	Y	–
4	*Cucurbita foetidissima*	buffalo gourd	Cucurbitaceae	CUFO	CUCFOE	–	–
4	*Cyphomeris gypsophiloides*	red cyphomeris	Nyctaginaceae	CYGY	CYPGYP	Y	–
4	*Dalea jamesii*	James' prairieclover	Fabaceae	DAJA	DALJAM	Y	–
4	*Dalea lanata* var. *terminalis*	woolly prairieclover	Fabaceae	DALAT	DALLAN	Y	–
4	*Dalea nana* var. *carnescens*	dwarf prairieclover	Fabaceae	DANAC	DALNANC	Y	–
4	*Dalea* spp.	prairieclover	Fabaceae	DALEA	DALEA	–	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

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4	*Dalea wrightii*	Wright's prairieclover	Fabaceae	DAWR	DALWRI	Y	GUMO-16601
4	*Descurainia* spp.	tansymustard	Brassicaceae	DESCU	DESCUR	–	–
4	*Desmanthus velutinis*	velvet bundleflower	Fabaceae	DEVE2	DESVEL	Y	–
4	*Dimorphocarpa wislizeni*	spectacle pod	Brassicaceae	DIWI2	DIMWIS	–	–
4	*Dyssodia papposa*	fetid marigold	Asteraceae	DYPA	DYSPAP	Y	–
4	*Echeandia flavescens*	Torrey's craglily	Liliaceae	ECFL	ECHFLA	Y	–
4	*Engelmannia peristenia*	Engelmann's daisy	Asteraceae	ENPE4	ENGPER	–	–
4	*Equisetum laevigatum*	smooth horsetail	Equisetaceae	EQLA	EQULAE	Y	–
4	*Erigeron divergens*	spreading fleabane	Asteraceae	ERDI4	ERIDIV	Y	–
4	*Erigeron flagellaris*	trailing fleabane	Asteraceae	ERFL	ERIFLA	Y	–
4	*Erigeron* spp.	fleabane	Asteraceae	ERIGE2	ERIGER	–	–
4	*Eriogonum havardii*	Havard's buckwheat	Polygonaceae	ERHA	ERIHAV	Y	–
4	*Eriogonum hieraciifolium*	hawkweed buckwheat	Polygonaceae	ERHI3	ERIHIE	Y	–
4	*Eriogonum jamesii*	James' buckwheat	Polygonaceae	ERJA	ERIJAM	–	–
4	*Eriogonum* spp.	buckwheat	Polygonaceae	ERIOG	ERIOGO	–	–
4	*Erodium cicutarium*	redstem stork's bill	Geraniaceae	ERCI6	EROCIC	–	–
4	*Erodium texanum*	Texas filaree	Geraniaceae	ERTE13	EROTEX	–	–
4	*Erysimum capitatum*	sanddune wallflower	Brassicaceae	ERCA14	ERYCAP	Y	–
4	*Euphorbia brachycera*	horned spurge	Euphorbiaceae	EUBR	EUPBRA	Y	–
4	*Euphorbia cyathophora*	fire on the mountain	Euphorbiaceae	EUCY	EUPCYA	Y	–
4	*Euphorbia davidii*	David's spurge	Euphorbiaceae	EUDA5	EUPDAV	Y	GUMO-16599
4	*Euphorbia exstipulata*	squareseed spurge	Euphorbiaceae	EUEX4	EUPEXS	Y	GUMO-16600
4	*Euphorbia* spp.	spurge	Euphorbiaceae	EUPHO	EUPHOR	–	–
4	*Evolvulus nuttallianus*	shaggy dwarf morningglory	Convolvulaceae	EVNU	EVONUT	Y	–
4	*Evolvulus sericeus*	silver dwarf morningglory	Convolvulaceae	EVSE	EVOSER	Y	GUMO-16589
4	*Fragaria* spp.	strawberry	Rosaceae	FRAGA	FRAGAR	–	–
4	*Fragaria vesca*	woodland strawberry	Rosaceae	FRVE	FRAVES	Y	–
4	*Frasera speciosa*	showy frasera	Gentianaceae	FRSP	FRASPE	Y	–
4	*Funastrum crispum*	wavyleaf twinevine	Asclepiadaceae	FUCR	FUNCRI	Y	–
4	*Gaillardia multiceps*	gypsum blanketflower	Asteraceae	GAMU	GAIMUL	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
4	*Gaillardia pinnatifida*	red dome blanketflower	Asteraceae	GAPI	GAIPIN	Y	–
4	*Galium mexicanum* ssp. *asperrimum*	Mexican bedstraw	Rubiaceae	GAMEA	GALMEX	Y	GUMO-16651
4	*Galium microphyllum*	bracted bedstraw	Rubiaceae	GAMI	GALMIC	Y	–
4	*Galium* spp.	bedstraw	Rubiaceae	GALIU	GALIUM	–	–
4	*Galium wrightii*	Wright's bedstraw	Rubiaceae	GAWR2	GALWRI2	Y	–
4	*Gaura coccinea*	scarlet beeblossom	Onagraceae	GACO5	GAUCOC	–	–
4	*Geranium caespitosum*	pineywoods geranium	Geraniaceae	GECA3	GERCAE	Y	–
4	*Geranium* spp.	geranium	Geraniaceae	GERAN	GERANI	–	–
4	*Giliastrum acerosum*	bluebowls	Polemoniaceae	GIAC4	GILACE	Y	–
4	*Giliastrum incisum*	splitleaf gilia	Polemoniaceae	GIIN6	GILINC2	Y	GUMO-16629
4	*Glandularia bipinnatifida*	Dakota mock vervain	Verbenaceae	GLBI2	GLABIP	–	–
4	*Glandularia bipinnatifida* var. *bipinnatifida*	Dakota mock vervain	Verbenaceae	GLBIB	GLABIP	Y	GUMO-16640
4	*Grindelia* spp.	gumweed	Asteraceae	GRIND	GRINDE	–	–
4	*Gutierrezia sphaerocephala*	roundleaf snakeweed	Asteraceae	GUSP	GUTSPH	Y	–
4	*Hackelia besseyi*	Bessey's stickseed	Boraginaceae	HABE3	HACBES	Y	–
4	*Hackelia* spp.	stickseed	Boraginaceae	HACKE	HACKEL	–	–
4	*Hedeoma costata* var. *pulczhella*	ribbed false pennyroyal	Lamiaceae	HECOP	HEDCOS	Y	–
4	*Hedeoma drummondii*	Drummond's false pennyroyal	Lamiaceae	HEDR	HEDDRU	Y	–
4	*Hedeoma nana*	dwarf false pennyroyal	Lamiaceae	HENA	HEDNAN	Y	–
4	*Hedeoma* spp.	false pennyroyal	Lamiaceae	HEDEO	HEDEOM	–	–
4	*Helianthus* spp.	common sunflower	Asteraceae	HELIA3	HELIAN	–	–
4	*Heliomeris multiflora*	showy goldeneye	Asteraceae	HEMU3	HELMUL	–	–
4	*Heterotheca fulcrata*	rockyscree falsegoldenaster	Asteraceae	HEFU3	HETFUL	Y	–
4	*Heterotheca fulcrata* var. *fulcrata*	rockyscree falsegoldenaster	Asteraceae	HEFUF	HETFUL	Y	–
4	*Heterotheca villosa*	hairy goldenaster	Asteraceae	HEVI4	HETVIL	–	–
4	*Heuchera rubescens*	pink alumroot	Saxifragaceae	HERU	HEURUB	Y	–
4	*Hexalectris warnockii*	Texas crested coralroot	Orchidaceae	HEWA	HEXWAR	Y	–
4	*Hieracium fendleri*	yellow hawkweed	Asteraceae	HIFE	HIEFEN	Y	–
4	*Hieracium* spp.	hawkweed	Asteraceae	HIERA	HIERAC	–	–
4	*Hoffmannseggia glauca*	Indian rushpea	Fabaceae	HOGL2	HOFGLA	Y	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
4	*Houstonia acerosa*	needleleaf bluet	Rubiaceae	HOAC	HOUACE	–	–
4	*Houstonia acerosa* var. *acerosa*	needleleaf bluet	Rubiaceae	HOACA2	HOUACE	Y	GUMO-16636
4	*Houstonia acerosa* var. *polypremoides*	needleleaf bluet	Rubiaceae	HOACP2	HOUACE	Y	GUMO-16637
4	*Hybanthus verticillatus*	babyslippers	Violaceae	HYVE	HYBVER	Y	GUMO-16641
4	*Hymenopappus biennis*	biennial woollywhite	Asteraceae	HYBI	HYMBIE	Y	–
4	*Hymenopappus flavescens* var. *canotomentosus*	collegeflower	Asteraceae	HYFLC	HYMFLA	Y	–
4	*Hymenoxys richardsonii*	pingue hymenoxys	Asteraceae	HYRI	HYMRIC	–	–
4	*Hymenoxys richardsonii* var. *floribunda*	Colorado rubberweed	Asteraceae	HYRIF	HYMRIC	Y	–
4	*Hymenoxys* spp.	rubberweed	Asteraceae	HYMEN7	HYMENO	–	–
4	*Ibervillea tenuisecta*	slimlobe globeberry	Cucurbitaceae	IBTE2	IBETEN	–	–
4	*Ipomoea costellata*	crestrib morningglory	Convolvulaceae	IPCO2	IPOCOS	Y	–
4	*Ipomoea cristulata*	Trans-Pecos morningglory	Convolvulaceae	IPCR	IPOCRI	Y	GUMO-16590
4	*Ipomoea lindheimeri*	Lindheimer's morningglory	Convolvulaceae	IPLI	IPOLIN	Y	–
4	*Ipomoea purpurea*	tall morningglory	Convolvulaceae	IPPU2	IPOPUR	Y	GUMO-16591
4	*Ipomoea tenuiloba*	trumpet morning glory	Convolvulaceae	IPTE	IPOTEN	Y	–
4	*Ipomopsis aggregata*	skyrocket gilia	Polemoniaceae	IPAG	IPOAGG	–	–
4	*Ipomopsis aggregata* ssp. *formosissima*	scarlet skyrocket	Polemoniaceae	IPAGF	IPOAGG	Y	–
4	*Krameria lanceolata*	trailing krameria	Krameriaceae	KRLA	KRALAN	Y	–
4	*Laennecia coulteri*	conyza	Asteraceae	LACO13	LAECOU	Y	–
4	Lamiaceae	mint family	Lamiaceae	LAMIAC	LAMIAC	–	–
4	*Lappula occidentalis*	flatspine stickseed	Boraginaceae	LAOC3	LAPOCC	–	–
4	*Lathyrus lanszwertii* var. *leucanthus*	Arizona peavine	Fabaceae	LALAL3	LATLAN	Y	–
4	*Lathyrus* spp.	peavine	Fabaceae	LATHY	LATHYR	Y	–
4	*Lepidium alyssoides* var. *angustifolium*	mountain pepperweed	Brassicaceae	LEALA4	LEPALY	Y	–
4	*Leuciva dealbata*	woolly marsh elder	Asteraceae	LEDE23	LEUDEA	Y	–
4	*Liatris punctata*	dotted gayfeather	Asteraceae	LIPU	LIAPUN	–	–
4	*Linum aristatum*	bristle flax	Linaceae	LIAR3	LINARI2	Y	–
4	*Linum australe* var. *australe*	southern flax	Linaceae	LIAUA	LINAUS	Y	–
4	*Linum lewisii*	prairie flax	Linaceae	LILE3	LINLEW	–	–
4	*Linum puberulum*	plains flax	Linaceae	LIPU4	LINPUB	Y	GUMO-16606

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

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4	*Linum schiedeanum*	Schied's flax	Linaceae	LISC5	LINSCH	Y	–
4	*Linum vernale*	Chihuahuan flax	Linaceae	LIVE2	LINVER	Y	–
4	*Lithospermum incisum*	narrowleaf gromwell	Boraginaceae	LIIN2	LITINC	–	–
4	*Lithospermum multiflorum*	manyflowered gromwell	Boraginaceae	LIMU3	LITMUL	Y	–
4	*Lithospermum* spp.	gromwell	Boraginaceae	LITHO3	LITHOS	–	–
4	*Lithospermum viride*	green gromwell	Boraginaceae	LIVI2	LITVIR	Y	–
4	*Lobelia cardinalis*	cardinalflower	Campanulaceae	LOCA2	LOBCAR	Y	–
4	*Lygodesmia texana*	Texas skeletonplant	Asteraceae	LYTE	LYGTEX	Y	–
4	*Machaeranthera tanacetifolia*	tanseyleaf aster	Asteraceae	MATA2	MACTAN	–	–
4	*Margaranthus solanaceus*	netted globecherry	Solanaceae	MASO4	MARSOL	Y	GUMO-16639
4	*Marrubium vulgare*	horehound	Lamiaceae	MAVU	MARVUL	Y	–
4	*Maurandella antirrhiniflora*	roving sailor	Plantaginaceae	MAAN9	MAUANT	Y	–
4	*Melampodium leucanthum*	plains blackfoot	Asteraceae	MELE2	MELLEU	Y	–
4	*Mentzelia humilis* var. *guadalupensis*	Guadalupe blazingstar	Loasaceae	MEHUG	MENHUM	Y	–
4	*Mentzelia oligosperma*	chickenthief	Loasaceae	MEOL	MENOLI	–	–
4	*Mentzelia saxicola*	El Paso blazingstar	Loasaceae	MESA2	MENSAX	Y	–
4	*Mentzelia* spp.	mentzelia	Loasaceae	MENTZ	MENTZE	–	–
4	*Mirabilis albida*	white four o'clock	Nyctaginaceae	MIAL4	MIRABI	–	–
4	*Mirabilis linearis*	narrowleaf four o'clock	Nyctaginaceae	MILI3	MIRLIN	Y	–
4	*Mirabilis multiflora*	Colorado four o'clock	Nyctaginaceae	MIMU	MIRMUL	Y	–
4	*Mirabilis oxybaphoides*	smooth spreading four o'clock	Nyctaginaceae	MIOX	MIROXY	Y	–
4	*Monotropa hypopithys*	pinesap	Monotropaceae	MOHY3	MONHYP	Y	–
4	*Nama carnosum*	sand fiddleleaf	Hydrophyllaceae	NACA	NAMCAR	Y	–
4	*Nama dichotomum*	wishbone fiddleleaf	Hydrophyllaceae	NADI	NAMDIC	Y	GUMO-16603
4	*Nama hispidum*	bristly nama	Hydrophyllaceae	NAHI	NAMHIS	–	–
4	*Nama xylopodum*	yellowseed fiddleleaf	Hydrophyllaceae	NAXY	NAMXYL	Y	–
4	*Nerisyrenia camporum*	mesa greggia	Brassicaceae	NECA3	NERCAM	Y	–
4	*Nerisyrenia linearifolia*	White Sands fanmustard	Brassicaceae	NELI	NERLIN	Y	–
4	*Nicotiana obtusifolia* var. *obtusifolia*	desert tobacco	Solanaceae	NIOBO	NICOBT	–	–
4	*Noccaea fendleri* ssp. *fendleri*	Fendler's pennycress	Brassicaceae	NOMOF	NOCFEN	Y	–

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4	*Nothoscordum bivalve*	crowpoison	Liliaceae	NOBI2	NOTBIV	Y	–
4	*Oenothera brachycarpa*	shortfruit eveningprimrose	Onagraceae	OEBR	OENBRA	Y	–
4	*Oenothera pallida* ssp. *runcinata*	pale eveningprimrose	Onagraceae	OEPAR	OENPAL	Y	–
4	*Oenothera* spp.	eveningprimrose	Onagraceae	OENOT	OENOTH	–	–
4	*Orobanche ludoviciana* ssp. *multiflora*	manyflowered broomrape	Orobanchaceae	ORLUM	OROLUD	Y	–
4	*Oxalis drummondii*	Drummond's woodsorrel	Oxalidaceae	OXDR	OXADRU	Y	–
4	*Oxalis* spp.	woodsorrel	Oxalidaceae	OXALI	OXALIS	–	–
4	*Packera hartiana*	Hart's ragwort	Asteraceae	PAHA16	PACHAR	–	–
4	*Packera* spp.	ragwort	Asteraceae	PACKE	PACKER	Y	–
4	*Paronychia jamesii*	James' nailwort	Caryophyllaceae	PAJA	PARJAM	Y	–
4	*Parthenium confertum* var. *lyratum*	Gray's feverfew	Asteraceae	PACOL	PARCON	Y	–
4	*Pectis angustifolia*	narrowleaf pectis	Asteraceae	PEAN	PECANG	Y	–
4	*Pellaea atropurpurea*	purple cliffbrake	Pteridaceae	PEAT2	PELATR	Y	–
4	*Penstemon barbatus*	beardlip penstemon	Plantaginaceae	PEBA2	PENBAR	Y	–
4	*Penstemon cardinalis* ssp. *regalis*	cardinal beardtongue	Plantaginaceae	PECAR	PENCAR	Y	–
4	*Penstemon jamesii*	James' beardtongue	Plantaginaceae	PEJA	PENJAM	Y	–
4	*Penstemon* spp.	beardtongue	Plantaginaceae	PENST	PENSTE	–	–
4	*Perityle quinqueflora*	five-flowered rockdaisy	Asteraceae	PEQU	PERQUI	Y	–
4	*Phacelia integrifolia*	gypsum scorpionweed	Hydrophyllaceae	PHIN	PHAINT	–	–
4	*Phacelia rupestris*	silky phacelia	Hydrophyllaceae	PHRU2	PHARUP	Y	GUMO-16604
4	*Phacelia* spp.	phacelia	Hydrophyllaceae	PHACE	PHACEL	Y	–
4	*Phemeranthus aurantiacus*	orange flameflower	Portulacaceae	PHAU13	PHEAUR	Y	–
4	*Phemeranthus brevicaulis*	dwarf fameflower	Portulacaceae	PHBR15	PHEBRE	Y	–
4	*Phlox* spp.	phlox	Polemoniaceae	PHLOX	PHLOX	–	–
4	*Phlox triovulata*	threeseed phlox	Polemoniaceae	PHTR	PHLTRI	Y	–
4	*Phyllanthus polygonoides*	smartweed leafflower	Euphorbiaceae	PHPO3	PHYPOL	Y	–
4	*Physalis hederifolia* var. *comata*	ivyleaf groundcherry	Solanaceae	PHHEC	PHYHED	Y	–
4	*Physalis hederifolia* var. *hederifolia*	ivyleaf groundcherry	Solanaceae	PHHEH2	PHYHED	Y	–
4	*Physaria fendleri*	Fendler's bladderpod	Brassicaceae	LEFE	PHYFEN	Y	–
4	*Physaria purpurea*	rose bladderpod	Brassicaceae	LEPU2	PHYPUR	Y	–

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4	*Physaria* spp.	twinpod	Brassicaceae	PHYSA2	PHYSAR	–	–
4	*Pinaropappus parvus*	small rocklettuce	Asteraceae	PIPA	PINPAR	Y	–
4	*Pinaropappus roseus*	white rocklettuce	Asteraceae	PIRO	PINROS	Y	–
4	*Plantago patagonica*	woolly plantain	Plantaginaceae	PLPA2	PLAPAT	–	–
4	*Polygala alba*	white milkwort	Polygalaceae	POAL4	POLALB	Y	–
4	*Polygala barbeyana*	blue milkwort	Polygalaceae	POBA	POLBAR	Y	–
4	*Polygala macradenia*	glandleaf milkwort	Polygalaceae	POMA7	POLMAC	Y	–
4	*Polygala rimulicola* var. *rimulicola*	Guadalupe milkwort	Polygalaceae	PORIR	POLRIM	Y	–
4	*Polygala scoparioides*	broom milkwort	Polygalaceae	POSC2	POLSCO	Y	–
4	*Polygonatum cobrense*	McKittrick's Solomon's seal	Liliaceae	POCO6	POLCOB	Y	–
4	*Portulaca oleracea*	common purslane	Portulacaceae	POOL	POROLE	–	–
4	*Portulaca pilosa*	kiss me quick	Portulacaceae	POPI3	PORPIL	Y	GUMO-16630
4	*Pseudocymopterus montanus*	alpine false springparsley	Apiaceae	PSMO	PSEMON	Y	–
4	*Pseudocymopterus* spp.	false springparsley	Apiaceae	PSEUD4	PSEUDO	–	–
4	*Pseudognaphalium canescens*	Wright's cudweed	Asteraceae	PSCA11	PSECAN	Y	GUMO-16583
4	*Pseudognaphalium stramineum*	cottonbatting cudweed	Asteraceae	PSST7	PSESTR	Y	–
4	*Pseudostellaria jamesiana*	tuber starwort	Caryophyllaceae	PSJA2	PSEJAM	Y	–
4	*Psilostrophe tagetina*	woolly paperflower	Asteraceae	PSTA	PSITAG	Y	–
4	*Ratibida columnifera*	upright prairie coneflower	Asteraceae	RACO3	RATCOL	–	–
4	*Rhynchosia senna* var. *texana*	Texas snoutbean	Fabaceae	RHSET	RHYSEN	Y	–
4	*Rhynchosida physocalyx*	buffpetal	Malvaceae	RHPH2	RHYPHY	Y	–
4	*Salsola tragus*	prickly Russian thistle	Chenopodiaceae	SATR12	SALTRA	Y	–
4	*Salvia farinacea*	mealycup sage	Lamiaceae	SAFA2	SALFAR	Y	–
4	*Salvia reflexa*	lanceleaf sage	Lamiaceae	SARE3	SALREF	Y	–
4	*Samolus ebracteatus* ssp. *cuneatus*	limewater brookweed	Primulaceae	SAEBC	SAMEBR	Y	GUMO-16631
4	*Sanvitalia abertii*	Albert's creeping zinnia	Asteraceae	SAAB	SANABE	Y	GUMO-16584
4	*Sartwellia flaveriae*	threadleaf glowwort	Asteraceae	SAFL5	SARFLA	Y	GUMO-16585
4	*Schiedeella arizonica*	parasitic lady's tresses	Orchidaceae	SCAR8	SCHARI	Y	–
4	*Schoenocaulon texanum*	Texas feathershank	Liliaceae	SCTE2	SCHTEX	Y	–
4	*Schoenocrambe linearifolia*	slimleaf plainsmustard	Brassicaceae	SCLI12	SCHLIN	Y	–

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4	*Scutellaria drummondii*	Drummond's skullcap	Lamiaceae	SCDR2	SCUDRU	Y	–
4	*Sedum* spp.	stonecrop	Crassulaceae	SEDUM	SEDUM	–	–
4	*Sedum wrightii*	Wright's stonecrop	Crassulaceae	SEWR	SEDWRI	Y	–
4	*Selaginella pilifera*	resurrection plant	Selaginellaceae	SEPI	SELPIL	Y	–
4	*Selaginella* spp.	spikemoss	Selaginellaceae	SELAG	SELAGI	–	–
4	*Selaginella wrightii*	Wright's spikemoss	Selaginellaceae	SEWR2	SELWRI	Y	GUMO-16638
4	*Senecio flaccidus* var. *flaccidus*	threadleaf ragwort	Asteraceae	SEFLF	SENFLA	Y	–
4	*Senecio* spp.	groundsel	Asteraceae	SENEC	SENECI	–	–
4	*Senna roemeriana*	twoleaf wild sensitive plant	Fabaceae	SERO8	SENROE	Y	–
4	*Seymeria scabra*	limpia blacksenna	Orobanchaceae	SESC3	SEYSCA	Y	–
4	*Sida abutifolia*	spreading fanpetals	Malvaceae	SIAB	SIDABU	Y	–
4	*Silene laciniata*	Mexican campion	Caryophyllaceae	SILA2	SILLAC	Y	–
4	*Sisyrinchium demissum*	dwarf blue-eyed grass	Iridaceae	SIDE4	SISDEM	Y	GUMO-16605
4	*Sisyrinchium* spp.	blue-eyed grass	Iridaceae	SISYR	SISYRI	–	–
4	*Solanaceae*	potato family	Solanaceae	SOLANA	SOLANA	–	–
4	*Solanum elaeagnifolium*	silverleaf nightshade	Solanaceae	SOEL	SOLELA	Y	–
4	*Solanum rostratum*	buffalobur nightshade	Solanaceae	SORO	SOLROS	–	–
4	*Solidago* spp.	goldenrod	Asteraceae	SOLID	SOLIDA	–	–
4	*Solidago wrightii* var. *guadalupensis*	Wright's goldenrod	Asteraceae	SOWR	SOLWRI	Y	–
4	*Sphaeralcea coccinea*	scarlet globemallow	Malvaceae	SPCO	SPHCOC	–	–
4	*Sphaeralcea fendleri*	Fendler's globemallow	Malvaceae	SPFE	SPHFEN	Y	–
4	*Sphaeralcea hastulata*	spear globemallow	Malvaceae	SPHA	SPHHAS	–	–
4	*Sphaeralcea incana*	gray globemallow	Malvaceae	SPIN2	SPHINC	Y	GUMO-16607
4	*Sphaeralcea* spp.	globemallow	Malvaceae	SPHAE	SPHAER	–	–
4	*Stenandrium barbatum*	early shaggytuft	Acanthaceae	STBA	STEBAR	–	–
4	*Stenaria nigricans* var. *nigricans*	diamond-flowers	Rubiaceae	STNIN	STENIG	Y	–
4	*Stephanomeria pauciflora*	brownplume wirelettuce	Asteraceae	STPA4	STEPAU	Y	–
4	*Talinum* spp.	flameflower	Portulacaceae	TALIN2	TALINU	–	–
4	*Tetraclea coulteri*	Coulter's wrinklefruit	Verbenaceae	TECO	TETCOU	Y	–
4	*Tetraneuris acaulis* var. *acaulis*	stemless four-nerve daisy	Asteraceae	TEACA2	TETACA	Y	–

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4	*Tetraneuris linearifolia* var. *linearifolia*	fineleaf fournerved daisy	Asteraceae	TELIL	TETLIN	Y	–
4	*Tetraneuris scaposa*	stemmy four-nerve daisy	Asteraceae	TESC2	TETSCA	–	–
4	*Tetraneuris scaposa* var. *scaposa*	stemmy four-nerve daisy	Asteraceae	TESCS	TETSCA	Y	–
4	*Tetraneuris* spp.	hymenoxys	Asteraceae	TETRA17	TETRAN	–	–
4	*Teucrium laciniatum*	lacy germander	Lamiaceae	TELA	TEULAC	Y	–
4	*Thalictrum fendleri*	Fendler's meadowrue	Ranunculaceae	THFE	THAFEN	Y	–
4	*Thamnosma texana*	rue of the mountains	Rutaceae	THTE2	THATEX	–	–
4	*Thelesperma longipes*	longstalk greenthread	Asteraceae	THLO	THELON	Y	–
4	*Thelesperma megapotamicum*	Hopi tea greenthread	Asteraceae	THME	THEMEG	–	–
4	*Thelesperma* spp.	greenthread	Asteraceae	THELE	THELES	–	–
4	*Thelypodium wrightii*	Wright's thelypody	Brassicaceae	THWR	THEWRI	Y	–
4	*Thymophylla pentachaeta*	fiveneedle pricklyleaf	Asteraceae	THPE4	THYPEN	–	–
4	*Thymophylla pentachaeta* var. *belenidium*	fiveneedle pricklyleaf	Asteraceae	THPEB	THYPEN	Y	–
4	*Tidestromia lanuginosa*	wooly tidestromia	Amaranthaceae	TILA2	TIDLAN	Y	–
4	*Townsendia annua*	annual townsend daisy	Asteraceae	TOAN	TOWANN	Y	–
4	*Tradescantia wrightii*	Wright's spiderwort	Commelinaceae	TRWR	TRAWRI	Y	–
4	*Tragia ramosa*	branched noseburn	Euphorbiaceae	TRRA5	TRARAM	Y	–
4	*Typha domingensis*	southern cattail	Typhaceae	TYDO	TYPDOM	Y	–
4	unidentified forb	unidentified forb	unknown	2FORB	UNIDF	Y	–
4	unidentified forb - seedling	unidentified forb - seedling	unknown	2FA	UNIDF	–	–
4	*Verbascum thapsus*	common mullein	Scrophulariaceae	VETH	VERTHA	–	–
4	*Verbena macdougalii*	MacDougal verbena	Verbenaceae	VEMA	VERMAC	Y	–
4	*Verbena perennis*	pinleaf vervain	Verbenaceae	VEPE	VERPER	Y	–
4	*Verbesina encelioides*	golden crownbeard	Asteraceae	VEEN	VERENC	Y	–
4	*Vicia americana*	American vetch	Fabaceae	VIAM	VICAME	Y	–
4	*Vicia* spp.	vetch	Fabaceae	VICIA	VICIA	–	–
4	*Viguiera cordifolia*	heartleaf goldeneye	Asteraceae	VICO	VIGCOR	Y	–
4	*Viguiera dentata*	toothleaf goldeneye	Asteraceae	VIDE3	VIGDEN	Y	–
4	*Viola missouriensis*	Missouri violet	Violaceae	VIMI3	VIOMIS	Y	–
4	*Viola* spp.	Violet	Violaceae	VIOLA	VIOLA	–	–

Table A1 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and species name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Species Name	Common Name	Family	PLANTS Symbol	NHNM Acronym	Vouchered	Park-NPS Catalog
4	*Xanthisma blephariphyllum*	Texas tansyaster	Asteraceae	MABL2	XANBLE	Y	–
4	*Xanthisma spinulosum*	lacy tansyaster	Asteraceae	MAPI	XANSPI2	–	–
4	*Xanthium strumarium*	rough cocklebur	Asteraceae	XAST	XANSTR	–	–
4	*Zinnia acerosa*	desert zinnia	Asteraceae	ZIAC	ZINACE	Y	–
4	*Zinnia grandiflora*	Rocky Mountain zinnia	Asteraceae	ZIGR	ZINGRA	Y	–
–	Asteraceae	sunflower family	Asteraceae	ASTERA	ASTERA	–	–
–	Cactaceae	cactus family	Cactaceae	CACTAC	CACTAC	–	–

Table A2. Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
1	alligator juniper	*Juniperus deppeana*	Cupressaceae	JUDE2	JUNDEP	–	–
1	bigtooth maple	*Acer grandidentatum*	Aceraceae	ACGR3	ACEGRA	Y	–
1	chinkapin oak	*Quercus muehlenbergii*	Fagaceae	QUMU	QUEMUE	Y	–
1	Douglas-fir	*Pseudotsuga menziesii*	Pinaceae	PSME	PSEMEN	–	–
1	Gambel oak	*Quercus gambelii*	Fagaceae	QUGA	QUEGAM	–	–
1	Granjeno desert hackberry	*Celtis pallida*	Ulmaceae	CEPA8	CELPAL	–	–
1	gray oak	*Quercus grisea*	Fagaceae	QUGR3	QUEGRI	Y	–
1	juniper	*Juniperus* spp.	Cupressaceae	JUNIP	JUNIPE	–	–
1	Knowlton's hophornbeam	*Ostrya knowltonii*	Betulaceae	OSKN	OSTKNO	Y	–
1	little walnut	*Juglans microcarpa*	Juglandaceae	JUMI	JUGMIC	–	–
1	netleaf hackberry	*Celtis laevigata* var. *reticulata*	Ulmaceae	CELAR	CELLAE	–	–
1	oneseed juniper	*Juniperus monosperma*	Cupressaceae	JUMO	JUNMON	Y	–
1	Pinchot's juniper	*Juniperus pinchotii*	Cupressaceae	JUPI	JUNPIN	Y	–
1	pinyon pine	*Pinus edulis*	Pinaceae	PIED	PINEDU	Y	–
1	ponderosa pine	*Pinus ponderosa*	Pinaceae	PIPO	PINPON	–	–
1	quaking aspen	*Populus tremuloides*	Salicaceae	POTR5	POPTRE	–	–
1	Rio Grande cottonwood	*Populus deltoides* ssp. *wislizeni*	Salicaceae	PODEW	POPDEL	Y	–
1	Rocky Mountain juniper	*Juniperus scopulorum*	Cupressaceae	JUSC2	JUNSCO	Y	–
1	Russian olive	*Elaeagnus angustifolia*	Elaeagnaceae	ELAN	ELAANG	–	–
1	Southwestern white pine	*Pinus strobiformis*	Pinaceae	PIST3	PINSTR	–	–
1	Texas madrone	*Arbutus xalapensis*	Ericaceae	ARXA80	ARBXAL	Y	–
1	velvet ash	*Fraxinus velutina*	Oleaceae	FRVE2	FRAVEL	Y	–
2	algerita	*Mahonia trifoliolata*	Berberidaceae	MATR3	MAHTRI	Y	–
2	Apacheplume	*Fallugia paradoxa*	Rosaceae	FAPA	FALPAR	–	–
2	Arizona honeysuckle	*Lonicera arizonica*	Caprifoliaceae	LOAR	LONARI	Y	–
2	banana yucca	*Yucca baccata*	Agavaceae	YUBA	YUCBAC	–	–
2	Berlandier's wolfberry	*Lycium berlandieri*	Solanaceae	LYBE	LYCBER	Y	–
2	Berlandier's wolfberry	*Lycium berlandieri* var. *parviflorum*	Solanaceae	LYBEP	LYCBER	Y	–
2	Big Bend silver-leaf	*Leucophyllum minus*	Scrophulariaceae	LEMI4	LEUMIN	Y	–
2	birchleaf buckthorn	*Frangula betulifolia*	Rhamnaceae	FRBE2	FRABET	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2	black cherry	*Prunus serotina*	Rosaceae	PRSE2	PRUSER	–	–
2	bluebill	*Clematis pitcheri*	Ranunculaceae	CLPI	CLEPIT	–	–
2	bluebill	*Clematis pitcheri* var. *dictyota*	Ranunculaceae	CLPID	CLEPIT	Y	–
2	brickellbush	*Brickellia* spp.	Asteraceae	BRICK	BRICKE	–	–
2	broom dalea	*Psorothamnus scoparius*	Fabaceae	PSSC6	PSOSCO	Y	–
2	bush croton	*Croton fruticulosus*	Euphorbiaceae	CRFR	CROFRU	Y	–
2	cactus apple	*Opuntia engelmannii*	Cactaceae	OPEN3	OPUENG	Y	–
2	California brickellbush	*Brickellia californica*	Asteraceae	BRCA3	BRICAL	Y	–
2	canyon grape	*Vitis arizonica*	Vitaceae	VIAR2	VITARI	Y	–
2	catclaw mimosa	*Mimosa aculeaticarpa* var. *biuncifera*	Fabaceae	MIACB	MIMACU	–	–
2	Christmas cactus	*Cylindropuntia leptocaulis*	Cactaceae	CYLE8	CYLLEP	–	–
2	cliff fendlerbrush	*Fendlera rupicola*	Hydrangeaceae	FERU	FENRUP	Y	–
2	Colorado barberry	*Berberis fendleri*	Berberidaceae	BEFE	BERFEN	–	–
2	common hoptree	*Ptelea trifoliata*	Rutaceae	PTTR	PTETRI	Y	–
2	creosotebush	*Larrea tridentata*	Zygophyllaceae	LATR2	LARTRI	–	–
2	currant; gooseberry	*Ribes* spp.	Grossulariaceae	RIBES	RIBES	–	–
2	desert ceanothus	*Ceanothus greggii*	Rhamnaceae	CEGR	CEAGRE	Y	–
2	desert rose	*Rosa stellata*	Rosaceae	ROST	ROSSTE	–	–
2	desert rose	*Rosa stellata* ssp. *mirifica* var. *erlansoniae*	Rosaceae	ROSTE2	ROSSTE	Y	–
2	desert snowberry	*Symphoricarpos longiflorus*	Caprifoliaceae	SYLO	SYMLON	Y	–
2	desert willow	*Chilopsis linearis*	Bignoniaceae	CHLI2	CHILIN	–	–
2	eggleaf silktassel	*Garrya ovata*	Garryaceae	GAOV	GAROVA	–	–
2	evergreen sumac	*Rhus virens*	Anacardiaceae	RHVI3	RHUVIR	–	–
2	evergreen sumac	*Rhus virens* var. *choriophylla*	Anacardiaceae	RHVIC	RHUVIR	–	–
2	evergreen sumac	*Rhus virens* var. *virens*	Anacardiaceae	RHVIV	RHUVIR	Y	–
2	false willow	*Baccharis salicina*	Asteraceae	BASA	BACSAL2	Y	–
2	fourwing saltbush	*Atriplex canescens*	Chenopodiaceae	ATCA2	ATRCAN	–	–
2	fragrant mimosa	*Mimosa borealis*	Fabaceae	MIBO2	MIMBOR	Y	–
2	frosted mint	*Poliomintha incana*	Lamiaceae	POIN3	POLINC	Y	–
2	giant dagger	*Yucca faxoniana*	Agavaceae	YUFA	YUCFAX	–	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2	Goldman's silktassel	*Garrya ovata* ssp. *goldmanii*	Garryaceae	GAOVG	GAROVAG	Y	–
2	green sotol	*Dasylirion leiophyllum*	Agavaceae	DALE2	DASLEI	–	–
2	Guadalupe rabbitbrush	*Lorandersonia spathulata*	Asteraceae	CHSP3	LORSPA	Y	–
2	honey mesquite	*Prosopis glandulosa*	Fabaceae	PRGL2	PROGLA	–	–
2	honeysuckle	*Lonicera* spp.	Caprifoliaceae	LONIC	LONICE	–	–
2	iodinebush	*Allenrolfea occidentalis*	Chenopodiaceae	ALOC2	ALLOCC	–	–
2	javelina bush	*Condalia ericoides*	Rhamnaceae	COER5	CONERI	Y	–
2	littleleaf mockorange	*Philadelphus microphyllus*	Hydrangeaceae	PHMI4	PHIMIC	Y	–
2	littleleaf sumac	*Rhus microphylla*	Anacardiaceae	RHMI3	RHUMIC	Y	–
2	longleaf jointfir	*Ephedra trifurca*	Ephedraceae	EPTR	EPHTRI	–	–
2	lotebush	*Ziziphus obtusifolia*	Rhamnaceae	ZIOB	ZIZOBT	–	–
2	mescal bean	*Sophora secundiflora*	Fabaceae	SOSE3	SOPSEC	–	–
2	Mescalero currant	*Ribes mescalarium*	Grossulariaceae	RIME2	RIBMES	Y	–
2	Mexican buckeye	*Ungnadia speciosa*	Sapindaceae	UNSP	UNGSPE	–	–
2	Mexican orange	*Choisya dumosa*	Rutaceae	CHDU	CHODUM	Y	–
2	mountain mahogany	*Cercocarpus montanus*	Rosaceae	CEMO2	CERMON	–	–
2	mountain ninebark	*Physocarpus monogynus*	Rosaceae	PHMO4	PHYMON	Y	GUMO-16635
2	New Mexico locust	*Robinia neomexicana*	Fabaceae	RONE	ROBNEO	–	–
2	New Mexico olive	*Forestiera pubescens* var. *pubescens*	Oleaceae	FOPUP	FORPUB	–	–
2	oak	*Quercus* spp.	Fagaceae	QUERC	QUERCU	–	–
2	obovate buckthorn	*Frangula betulifolia* ssp. *obovata*	Rhamnaceae	FRBEO	FRABET	Y	–
2	ocotillo	*Fouquieria splendens*	Fouquieriaceae	FOSP2	FOUSPL	–	–
2	Palmer's snowberry	*Symphoricarpos palmeri*	Caprifoliaceae	SYPA	SYMPAL	Y	GUMO-16649
2	prairie sumac	*Rhus lanceolata*	Anacardiaceae	RHLA3	RHULAN	Y	–
2	pungent oak	*Quercus pungens*	Fagaceae	QUPU	QUEPUN	Y	–
2	rabbitbrush	*Lorandersonia* spp.	Asteraceae	CHRYS9	LORAND	–	–
2	red barberry	*Mahonia haematocarpa*	Berberidaceae	MAHA4	MAHHAE	Y	–
2	Rio Grande saddlebush	*Mortonia scabrella*	Celastraceae	MOSC	MORSCA	Y	–
2	rockspirea	*Holodiscus dumosus*	Rosaceae	HODU	HOLDUM	Y	–
2	rough jointfir	*Ephedra aspera*	Ephedraceae	EPAS	EPHASP	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2	rubber rabbitbrush	*Ericameria nauseosa*	Asteraceae	ERNA10	ERINAU	–	–
2	rubber rabbitbrush	*Ericameria nauseosus* var. *texensis*	Asteraceae	ERNAT2	ERINAU	Y	–
2	shaggy mountain mahogany	*Cercocarpus montanus* var. *paucidentatus*	Rosaceae	CEMOP	CERMON	Y	–
2	silver mountain mahogany	Cercocarpus montanus var. argenteus	Rosaceae	CEMOA	CERMON	Y	–
2	skeletonleaf goldeneye	*Viguiera stenoloba*	Asteraceae	VIST	VIGSTE	–	–
2	skunkbush sumac	*Rhus trilobata*	Anacardiaceae	RHTR	RHUTRI	Y	–
2	snowberry	*Symphoricarpos* spp.	Caprifoliaceae	SYMPH	SYMPHO	Y	–
2	soaptree yucca	*Yucca elata*	Agavaceae	YUEL	YUCELA	–	–
2	southwestern chokecherry	*Prunus serotina* var. *virens*	Rosaceae	PRSEV	PRUSER	Y	GUMO-16648
2	southwestern rabbitbrush	*Lorandersonia pulchella*	Asteraceae	CHPU4	LORPUL	Y	GUMO-16581
2	spiny greasebush	*Glossopetalon spinescens*	Crossosomataceae	GLSP	GLOSPI	–	–
2	spiny greasebush	*Glossopetalon spinescens* var. *spinescens*	Crossosomataceae	GLSPS	GLOSPI	Y	–
2	splitleaf brickellbush	*Brickellia laciniata*	Asteraceae	BRLA	BRILAC	–	–
2	tarbush	*Flourensia cernua*	Asteraceae	FLCE	FLOCER	–	–
2	Texas mulberry	*Morus microphylla*	Moraceae	MOMI	MORMIC	Y	–
2	Texas sacahuista	*Nolina texana*	Agavaceae	NOTE	NOLTEX	Y	GUMO-16643
2	thicket creeper	*Parthenocissus vitacea*	Vitaceae	PAVI5	PARVIT	Y	GUMO-16642
2	Torrey's jointfir	*Ephedra torreyana*	Ephedraceae	EPTO	EPHTOR	Y	–
2	Torrey's yucca	*Yucca torreyi*	Agavaceae	YUTO	YUCTOR	Y	–
2	Trans-Pecos poreleaf	*Porophyllum scoparium*	Asteraceae	POSC6	PORSCO	Y	GUMO-16582
2	tree cholla	*Cylindropuntia imbricata*	Cactaceae	CYIM2	CLYIMB	–	–
2	unidentified shrub	unidentified shrub	unknown	2SHRUB	UNIDS	–	–
2	utah fendlerbush	*Fendlerella utahensis*	Hydrangeaceae	FEUT	FENUTA	Y	–
2	Utah serviceberry	*Amelanchier utahensis*	Rosaceae	AMUT	AMEUTA	Y	–
2	viscid acacia	*Acacia neovernicosa*	Fabaceae	ACNE4	ACANEO	Y	–
2	Warnock's snakewood	*Condalia warnockii*	Rhamnaceae	COWA	CONWAR	Y	–
2	wavyleaf oak	*Quercus* × *pauciloba*	Fagaceae	QUPA4	QUEPAU	Y	GUMO-16602
2	western white honeysuckle	*Lonicera albiflora*	Caprifoliaceae	LOAL	LONALB	Y	–
2	whitethorn acacia	*Acacia constricta*	Fabaceae	ACCO2	ACACON	Y	–
2	whortleleaf snowberry	*Symphoricarpos oreophilus*	Caprifoliaceae	SYOR2	SYMORE	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2	winterfat	*Krascheninnikovia lanata*	Chenopodiaceae	KRLA2	KRALAN2	–	–
2	Woods' rose	*Rosa woodsii*	Rosaceae	ROWO	ROSWOO	Y	–
2	Wright's beebrush	*Aloysia wrightii*	Verbenaceae	ALWR	ALOWRI	Y	–
2	yerba de pasmo	*Baccharis pteronioides*	Asteraceae	BAPT	BACPTE	Y	GUMO-16580
2.5	agave family	Agavaceae	Agavaceae	AGAVAC	AGAVAC	Y	–
2.5	arroyo flameflower	*Talinopsis frutescens*	Portulacaceae	TAFR	TALFRU	Y	–
2.5	beehive cactus	*Escobaria* spp.	Cactaceae	ESCOB	ESCOBA	–	–
2.5	black prairieclover	*Dalea frutescens*	Fabaceae	DAFR2	DALFRU	Y	–
2.5	broom snakeweed	*Gutierrezia sarothrae*	Asteraceae	GUSA2	GUTSAR	Y	–
2.5	brownspine hedgehog cactus	*Echinocereus viridiflorus var. chloranthus*	Cactaceae	ECVIC6	ECHVIR	–	–
2.5	bush seepweed	*Suaeda nigra*	Chenopodiaceae	SUNI	SUANIG	Y	GUMO-16587
2.5	canyon sage	*Salvia lycioides*	Lamiaceae	SALY	SALLYC	Y	–
2.5	Chihuahuan fishhook cactus	*Sclerocactus uncinatus* var. *wrightii*	Cactaceae	SCUNW	SCLUNC	–	–
2.5	Cooley's bundleflower	*Desmanthus cooleyi*	Fabaceae	DECO2	DESCOO	–	–
2.5	Cory's mistletoe	*Phoradendron coryae*	Viscaceae	PHCO14	PHOCOR	Y	–
2.5	crinklemat	*Tiquilia* spp.	Boraginaceae	TIQUI	TIQUIL	–	–
2.5	damiantia	*Chrysactinia mexicana*	Asteraceae	CHME3	CHRMEX	Y	–
2.5	dense ayenia	*Ayenia microphylla*	Sterculiaceae	AYMI	AYENIA	Y	–
2.5	devilshead	*Echinocactus horizonthalonius*	Cactaceae	ECHO	ECHHOR	Y	–
2.5	Douglas fir dwarf mistletoe	*Arceuthobium douglasii*	Viscaceae	ARDO	ARCDOU	Y	–
2.5	echinocactus	*Echinocactus* spp.	Cactaceae	ECHIN2	ECHINO	–	–
2.5	false boneset	*Brickellia eupatorioides* var. *chlorolepis*	Asteraceae	BREUC2	BRIEUP	Y	–
2.5	featherplume	*Dalea formosa*	Fabaceae	DAFO	DALFOR	Y	–
2.5	fragrant snakeroot	*Ageratina herbacea*	Asteraceae	AGHE5	AGEHER	Y	GUMO-16578
2.5	Graham's club-cholla	*Grusonia grahamii*	Cactaceae	GRGR6	GRUGRA	–	–
2.5	gumhead	*Gymnosperma glutinosum*	Asteraceae	GYGL	GYMGLU	Y	–
2.5	hairy crinklemat	*Tiquilia hispidissima*	Boraginaceae	TIHI	TIQHIS	Y	–
2.5	Havard's false willow	*Baccharis havardii*	Asteraceae	BAHA2	BACHAV	Y	–
2.5	hedgehog cactus	*Echinocereus* spp.	Cactaceae	ECHIN3	ECHINO2	–	–
2.5	kingcup cactus	*Echinocereus triglochidiatus*	Cactaceae	ECTR	ECHTRI	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2.5	lechuguilla	*Agave lechuguilla*	Agavaceae	AGLE	AGALEC	–	–
2.5	little nipple cactus	*Mammillaria meiacantha*	Cactaceae	MAME6	MAMMEI	Y	–
2.5	mariola	*Parthenium incanum*	Asteraceae	PAIN2	PARINC	–	–
2.5	mat rockspirea	*Petrophyton caespitosum*	Rosaceae	PECA12	PETCAE	Y	–
2.5	nylon hedgehog cactus	*Echinocereus viridiflorus*	Cactaceae	ECVI2	ECHVIR	Y	–
2.5	Oregongrape	*Mahonia repens*	Berberidaceae	MARE11	MAHREP	Y	–
2.5	paleface	*Hibiscus denudatus*	Malvaceae	HIDE	HIBDEN	Y	–
2.5	Parry's agave	*Agave parryi*	Agavaceae	AGPA4	AGAPAR	–	–
2.5	Parry's agave	*Agave parryi* ssp. *neomexicana*	Agavaceae	AGPAN6	AGAPAR	Y	–
2.5	pingpong ball cactus	*Epithelantha micromeris*	Cactaceae	EPMI2	EPIMIC	Y	–
2.5	pitaya	*Echinocereus enneacanthus*	Cactaceae	ECEN2	ECHENN	Y	–
2.5	plains pricklypear	*Opuntia polyacantha*	Cactaceae	OPPO	OPUPOL	–	–
2.5	plumed crinklemat	*Tiquilia greggii*	Boraginaceae	TIGR	TIQGRE	Y	–
2.5	prairie acacia	*Acacia angustissima*	Fabaceae	ACAN	ACAANG	Y	–
2.5	pricklyleaf dogweed	*Thymophylla acerosa*	Asteraceae	THAC	THYACE	Y	–
2.5	pricklypear	*Opuntia* spp.	Cactaceae	OPUNT	OPUNTI	–	–
2.5	purple pricklypear	*Opuntia macrocentra*	Cactaceae	OPMA8	OPUMAC	–	–
2.5	rainbow cactus	*Echinocereus dasyacanthus*	Cactaceae	ECDA	ECHDAS	Y	–
2.5	rainbow cactus	*Echinocereus pectinatus*	Cactaceae	ECPE	ECHPEC	–	–
2.5	rough menodora	*Menodora scabra*	Oleaceae	MESC	MENSCA	Y	–
2.5	scarlet hedgehog cactus	*Echinocereus coccineus*	Cactaceae	ECCO5	ECHCOC	–	–
2.5	showy menodora	*Menodora longiflora*	Oleaceae	MELO2	MENLON	Y	–
2.5	silver prairieclover	*Dalea bicolor* var. *argyraea*	Fabaceae	DABIA	DALBICA	Y	–
2.5	slimfoot century plant	*Agave gracilipes*	Agavaceae	AGGR4	AGAGRA	Y	–
2.5	southern jimmyweed	*Isocoma pluriflora*	Asteraceae	ISPL	ISOPLU	Y	–
2.5	spinystar	*Escobaria vivipara*	Cactaceae	ESVI2	ESCVIV	–	–
2.5	strawberry hedgehog cactus	*Echinocereus stramineus*	Cactaceae	ECST2	ECHSTR	Y	–
2.5	tasselflower brickellbush	*Brickellia grandiflora*	Asteraceae	BRGR	BRIGRA	Y	–
2.5	Texas pricklyleaf	*Thymophylla setifolia* var. *radiata*	Asteraceae	THSER	THYSET	Y	–
2.5	tulip pricklypear	*Opuntia phaeacantha*	Cactaceae	OPPH	OPUPHA	Y	–

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LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
2.5	unidentified subshrub	unidentified subshrub	unknown	2SUBS	UNIDDS	–	–
2.5	Warnock's water-willow	*Justicia warnockii*	Acanthaceae	JUWA	JUSWAR	Y	GUMO-16576
2.5	white fishhook cactus	*Echinomastus intertextus*	Cactaceae	ECIN2	ECHINT	Y	–
2.5	white ratany	*Krameria grayi*	Krameriaceae	KRGR	KRAGRA	Y	–
2.5	whitecolumn foxtail cactus	*Escobaria tuberculosa*	Cactaceae	ESTU	ESCTUB	Y	–
2.5	woody crinklemat	*Tiquilia canescens*	Boraginaceae	TICA3	TIQCAN	Y	–
2.5	Wright's baccharis	*Baccharis wrightii*	Asteraceae	BAWR	BACWRI	–	–
2.5	Wright's buckwheat	*Eriogonum wrightii*	Polygonaceae	ERWR	ERIWRI	Y	–
2.5	Wright's snakeroot	*Ageratina wrightii*	Asteraceae	AGWR2	AGEWRI	Y	GUMO-16579
3	alkali muhly	*Muhlenbergia asperifolia*	Poaceae	MUAS	MUHASP	Y	–
3	alkali sacaton	*Sporobolus airoides*	Poaceae	SPAI	SPOAIR	–	–
3	American bulrush	*Schoenoplectus americanus*	Cyperaceae	SCAM6	SCHAME	Y	–
3	Arizona cottontop	*Digitaria californica*	Poaceae	DICA8	DIGCAL	Y	GUMO-16617
3	Arizona fescue	*Festuca arizonica*	Poaceae	FEAR2	FESARI	Y	–
3	Arizona wheatgrass	*Elymus arizonicus*	Poaceae	ELAR7	ELYARI	Y	–
3	beaked spikerush	*Eleocharis rostellata*	Cyperaceae	ELRO2	ELEROS	Y	–
3	beardless rabbitsfoot	*Polypogon viridis*	Poaceae	POVI9	POLVIR	Y	–
3	bermudagrass	*Cynodon dactylon*	Poaceae	CYDA	CYNDAC	–	–
3	big bluestem	*Andropogon gerardii*	Poaceae	ANGE	ANDGER	Y	–
3	big sacaton	*Sporobolus wrightii*	Poaceae	SPWR2	SPOWRI	–	–
3	black grama	*Bouteloua eriopoda*	Poaceae	BOER4	BOUERI	Y	–
3	blue grama	*Bouteloua gracilis*	Poaceae	BOGR2	BOUGRA	–	–
3	bluebunch wheatgrass	*Pseudoroegneria spicata*	Poaceae	PSSP6	PSESPI	Y	GUMO-16627
3	bluestem	*Andropogon* spp.	Poaceae	ANDRO2	ANDROP	–	–
3	bottlebrush squirreltail	*Elymus elymoides*	Poaceae	ELEL5	ELYELY	Y	–
3	bristly wolfstail	*Lycurus setosus*	Poaceae	LYSE3	LYCSET	Y	GUMO-16647
3	brome	*Bromus* spp.	Poaceae	BROMU	BROMUS	–	–
3	buffalograss	*Buchloe dactyloides*	Poaceae	BODA2	BUCDAC	–	–
3	bulb panicgrass	*Panicum bulbosum*	Poaceae	PABU	PANBUL	Y	–
3	bullgrass	*Muhlenbergia emersleyi*	Poaceae	MUEM	MUHEME	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
3	burrograss	*Scleropogon brevifolius*	Poaceae	SCBR2	SCLBRE	–	–
3	bush muhly	*Muhlenbergia porteri*	Poaceae	MUPO2	MUHPOR	Y	–
3	California sawgrass	*Cladium californicum*	Cyperaceae	CLCA2	CLACAL	Y	–
3	Canada wildrye	*Elymus canadensis*	Poaceae	ELCA4	ELYCAN	–	–
3	cane bluestem	*Bothriochloa barbinodis*	Poaceae	BOBA3	BOTBAR	Y	–
3	cedar sedge	*Carex planostachys*	Cyperaceae	CAPL3	CARPLA	Y	GUMO-16593
3	creeping muhly	*Muhlenbergia repens*	Poaceae	MURE	MUHFEP	–	–
3	curlyleaf muhly	*Muhlenbergia setifolia*	Poaceae	MUSE	MUHSET	Y	–
3	ear muhly	*Muhlenbergia arenacea*	Poaceae	MUAR	MUHARE	–	–
3	false buffalograss	*Munroa squarrosa*	Poaceae	MUSQ3	MUNSQU	–	–
3	Fendler's flatsedge	*Cyperus fendlerianus*	Cyperaceae	CYFE2	CYPFEN	Y	GUMO-16594
3	Finestem needlegrass	*Nassella tenuissima*	Poaceae	NATE3	NASTEN	Y	–
3	flatsedge	*Cyperus* spp.	Cyperaceae	CYPER	CYPERU	–	–
3	fluffgrass	*Dasyochloa pulchella*	Poaceae	DAPU7	DASPUL	Y	GUMO-16616
3	fowl mannagrass	*Glyceria striata*	Poaceae	GLST	GLYSTR	Y	–
3	fringed brome	*Bromus ciliatus*	Poaceae	BRCI2	BROCIL	–	–
3	giant dropseed	*Sporobolus giganteus*	Poaceae	SPGI	SPOGIG	Y	–
3	green sprangletop	*Leptochloa dubia*	Poaceae	LEDU	LEPDUB	Y	–
3	Guadalupe needlegrass	*Achnatherum curvifolium*	Poaceae	ACCU6	ACHCUR	Y	GUMO-16650
3	gyp dropseed	*Sporobolus nealleyi*	Poaceae	SPNE	SPONEA	Y	–
3	gypsum grama	*Bouteloua breviseta*	Poaceae	BOBR	BOUBRE	Y	–
3	hairy grama	*Bouteloua hirsuta*	Poaceae	BOHI2	BOUHIR	Y	–
3	hairy woollygrass	*Erioneuron pilosum*	Poaceae	ERPI5	ERIPIL	Y	–
3	Hall's panicgrass	*Panicum hallii*	Poaceae	PAHA	PANHAL	Y	–
3	Indian ricegrass	*Achnatherum hymenoides*	Poaceae	ACHY	ACHHYM	–	–
3	Lehmann's lovegrass	*Eragrostis lehmanniana*	Poaceae	ERLE	ERALEH	Y	GUMO-16619
3	little awn needlegrass	*Achnatherum lobatum*	Poaceae	ACLO7	ACHLOB	Y	–
3	little bluestem	*Schizachyrium scoparium*	Poaceae	SCSC	SCHSCO	Y	–
3	littleseed ricegrass	*Piptatherum micranthum*	Poaceae	PIMI7	PIPMIC	–	–
3	littletooth sedge	*Carex microdonta*	Cyperaceae	CAMI5	CARMIC	Y	GUMO-16592

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
3	lovegrass	*Eragrostis* spp.	Poaceae	ERAGR	ERAGRO	–	–
3	meadow fescue	*Festuca pratensis*	Poaceae	FEPR	FESPRA	Y	–
3	mesa dropseed	*Sporobolus flexuosus*	Poaceae	SPFL2	SPOFLE	–	–
3	mountain muhly	*Muhlenbergia montana*	Poaceae	MUMO	MUHMON	Y	GUMO-16625
3	muhly	*Muhlenbergia* spp.	Poaceae	MUHLE	MUHLEN	–	–
3	muttongrass	*Poa fendleriana*	Poaceae	POFE	POAFEN	Y	–
3	Nealley's threeawn	*Aristida purpurea* var. *nealleyi*	Poaceae	ARPUN	ARIPUR	Y	–
3	needle and thread	*Hesperostipa* spp.	Poaceae	HESPE11	HESPER	Y	–
3	needle grama	*Bouteloua aristidoides*	Poaceae	BOAR	BOUARI	Y	GUMO-16611
3	needle-and-thread grass	*Hesperostipa comata*	Poaceae	HECO26	HESCOM	Y	–
3	needle-and-thread grass	*Hesperostipa comata* ssp. *comata*	Poaceae	HECOC8	HESCOM	Y	GUMO-16620
3	needlegrass	*Achnatherum* spp.	Poaceae	ACHNA	ACHNAT	–	–
3	New Mexico muhly	*Muhlenbergia pauciflora*	Poaceae	MUPA2	MUHPAU	Y	–
3	New Mexico needlegrass	*Hesperostipa neomexicana*	Poaceae	HENE5	HESNEO	Y	–
3	nineawn pappusgrass	*Enneapogon desvauxii*	Poaceae	ENDE	ENNDES	Y	–
3	oneflower grama	*Bouteloua uniflora*	Poaceae	BOUN	BOUUNI	Y	GUMO-16612
3	panicgrass	*Panicum* spp.	Poaceae	PANIC	PANICU	–	–
3	pine dropseed	*Blepharoneuron tricholepis*	Poaceae	BLTR	BLETRI	Y	–
3	pine muhly	*Muhlenbergia dubia*	Poaceae	MUDU	MUHDUB	Y	GUMO-16624
3	pinyon ricegrass	*Piptochaetium fimbriatum*	Poaceae	PIFI	PIPFIM	Y	–
3	plains lovegrass	*Eragrostis intermedia*	Poaceae	ERIN	ERAINT	Y	–
3	Porter brome	*Bromus porteri*	Poaceae	BRPO2	BROPOR	Y	GUMO-16615
3	poverty threeawn	*Aristida divarcata*	Poaceae	ARDI5	ARIDIV	–	–
3	prairie junegrass	*Koeleria macrantha*	Poaceae	KOMA	KOEMAC	–	–
3	Pringle needlegrass	*Piptochaetium pringlei*	Poaceae	PIPR2	PIPPRI	Y	–
3	purple threeawn	*Aristida purpurea*	Poaceae	ARPU9	ARIPUR	Y	–
3	purple threeawn	*Aristida purpurea* var. *purpurea*	Poaceae	ARPUP6	ARIPUR	Y	GUMO-16609
3	Rusby's flatsedge	*Cyperus sphaerolepis*	Cyperaceae	CYSP7	CYPSPH	Y	GUMO-16595
3	sand bluestem	*Andropogon hallii*	Poaceae	ANHA	ANDHAL	Y	GUMO-16608
3	sand dropseed	*Sporobolus cryptandrus*	Poaceae	SPCR	SPOCRY	Y	–

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LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
3	sand muhly	*Muhlenbergia arenicola*	Poaceae	MUAR2	MUHARE2	Y	GUMO-16622
3	Schiede's sedge	*Carex muriculata*	Cyperaceae	CAMU8	CARMUR	Y	–
3	Scribner's rosette grass	*Dichanthelium oligosanthes* var. *scribnerianum*	Poaceae	DIOLS	DICOLI	Y	–
3	shortleaf woollygrass	*Erioneuron avenaceum*	Poaceae	ERAV	ERIAVE	Y	–
3	sideoats grama	*Bouteloua curtipendula*	Poaceae	BOCU	BOUCUR	Y	–
3	silver beardgrass	*Bothriochloa laguroides*	Poaceae	BOLA2	BOTLAG	–	–
3	silver beardgrass	*Bothriochloa laguroides* ssp. *torreyana*	Poaceae	BOLAT	BOTLAG	Y	GUMO-16610
3	sixweeks grama	*Bouteloua barbata*	Poaceae	BOBA2	BOUBAR	Y	–
3	sixweeks muhly	*Muhlenbergia depauperata*	Poaceae	MUDE	MUHDEP	Y	GUMO-16623
3	sixweeks threeawn	*Aristida adscensionis*	Poaceae	ARAD	ARIADS	–	–
3	slender rush	*Juncus dudleyi*	Juncaceae	JUDU2	JUNDUD	Y	–
3	slim tridens	*Tridens muticus*	Poaceae	TRMU	TRIMUT	–	–
3	slim tridens	*Tridens muticus* var. *muticus*	Poaceae	TRMUM	TRIMUT	Y	–
3	slimflower muhly	*Muhlenbergia tenuifolia*	Poaceae	MUTE4	MUHTEN	Y	GUMO-16626
3	sm. upland sedge <25 cm	*Carex* spp. - upland small	Cyperaceae	CAREX	CAREX	Y	–
3	smooth brome	*Bromus inermis*	Poaceae	BRIN2	BROINE	–	–
3	southwestern needlegrass	*Achnatherum eminens*	Poaceae	ACEM4	ACHEMI	Y	–
3	spidergrass	*Aristida ternipes*	Poaceae	ARTE3	ARITER	–	–
3	spike dropseed	*Sporobolus contractus*	Poaceae	SPCO4	SPOCON	–	–
3	spike muhly	*Muhlenbergia wrightii*	Poaceae	MUWR	MUHWRI	–	–
3	stinkgrass	*Eragrostis cilianensis*	Poaceae	ERCI	ERACIL	Y	GUMO-16618
3	streambed bristlegrass	*Setaria leucopila*	Poaceae	SELE6	SETLEU	Y	GUMO-16628
3	switchgrass	*Panicum virgatum*	Poaceae	PAVI2	PANVIR	Y	–
3	tall upland sedge >25 cm	Carex spp. - upland tall	Cyperaceae	CAREX	CAREX	Y	–
3	tanglehead	*Heteropogon contortus*	Poaceae	HECO10	HETCON	Y	GUMO-16621
3	threeawn	*Aristida* spp.	Poaceae	ARIST	ARISTI	–	–
3	threeflower melicgrass	*Melica nitens*	Poaceae	MENI	MELNIT	Y	–
3	Torrey's rush	*Juncus torreyi*	Juncaceae	JUTO	JUNTOR	Y	–
3	unidentified graminoid	*unidentified graminoid*	unknown	2GRAM	UNIDG	–	–
3	vine mesquite	*Panicum obtusum*	Poaceae	PAOB	PANOBT	Y	–

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LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
3	Warnock's grama	*Bouteloua warnockii*	Poaceae	BOWA	BOUWAR	Y	–
3	weeping brome	*Bromus frondosus*	Poaceae	BRFR2	BROFRO	Y	GUMO-16613
3	western wheatgrass	*Pascopyrum smithii*	Poaceae	PASM	PASSMI	–	–
3	western witchgrass	*Digitaria pubiflora*	Poaceae	DIPU9	DIGPUB	Y	–
3	White Mountain sedge	*Carex geophila*	Cyperaceae	CAGE	CARGEO	–	–
3	wildrye	*Elymus* spp.	Poaceae	ELYMU	ELYMUS	–	–
3	woolly brome	*Bromus lanatipes*	Poaceae	BRLA6	BROLAN	Y	GUMO-16614
3	Wooton's threeawn	*Aristida pansa*	Poaceae	ARPA9	ARIPAN	Y	–
3	Wright's threeawn	*Aristida purpurea* var. *wrightii*	Poaceae	ARPUW	ARIPUR	Y	GUMO-16646
4	Albert's creeping zinnia	*Sanvitalia abertii*	Asteraceae	SAAB	SANABE	Y	GUMO-16584
4	alpine false springparsley	*Pseudocymopterus montanus*	Apiaceae	PSMO	PSEMON	Y	–
4	American vetch	*Vicia americana*	Fabaceae	VIAM	VICAME	Y	–
4	angel's trumpets	*Acleisanthes longiflora*	Nyctaginaceae	ACLO2	ACLLON	–	–
4	annual townsend daisy	*Townsendia annua*	Asteraceae	TOAN	TOWANN	Y	–
4	annual windmills	*Allionia choisyi*	Nyctaginaceae	ALCH	ALLCHO	–	–
4	Arizona peavine	*Lathyrus lanszwertii* var. *leucanthus*	Fabaceae	LALAL3	LATLAN	Y	–
4	aster	*Aster* spp.	Asteraceae	ASTER	ASTER	–	–
4	babyslippers	*Hybanthus verticillatus*	Violaceae	HYVE	HYBVER	Y	GUMO-16641
4	beardlip penstemon	*Penstemon barbatus*	Plantaginaceae	PEBA2	PENBAR	Y	–
4	beardtongue	*Penstemon* spp.	Plantaginaceae	PENST	PENSTE	–	–
4	bedstraw	*Galium* spp.	Rubiaceae	GALIU	GALIUM	–	–
4	Bessey's stickseed	*Hackelia besseyi*	Boraginaceae	HABE3	HACBES	Y	–
4	biennial woollywhite	*Hymenopappus biennis*	Asteraceae	HYBI	HYMBIE	Y	–
4	Bigelow's beggarticks	*Bidens bigelovii*	Asteraceae	BIBI	BIDBIG	Y	–
4	birdbill dayflower	*Commelina dianthifolia*	Commelinaceae	CODI4	COMDIA	Y	GUMO-16644
4	blackstem spleenwort	*Asplenium resiliens*	Aspleniaceae	ASRE	ASPRES	Y	–
4	blue milkwort	*Polygala barbeyana*	Polygalaceae	POBA	POLBAR	Y	–
4	bluebell bellflower	*Campanula rotundifolia*	Campanulaceae	CARO2	CAMROT	Y	–
4	bluebowls	*Giliastrum acerosum*	Polemoniaceae	GIAC4	GILACE	Y	–
4	blue-eyed grass	*Sisyrinchium* spp.	Iridaceae	SISYR	SISYRI	–	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	bluntscale bahia	*Bahia pedata*	Asteraceae	BAPE	BAHPED	Y	–
4	bracted bedstraw	*Galium microphyllum*	Rubiaceae	GAMI	GALMIC	Y	–
4	branched noseburn	*Tragia ramosa*	Euphorbiaceae	TRRA5	TRARAM	Y	–
4	bristle flax	*Linum aristatum*	Linaceae	LIAR3	LINARI2	Y	–
4	bristlecup sandmat	*Chamaesyce chaetocalyx*	Euphorbiaceae	CHCH5	CHACHA	Y	GUMO-16645
4	bristly nama	*Nama hispidum*	Hydrophyllaceae	NAHI	NAMHIS	–	–
4	broadleaf milkweed	*Asclepias latifolia*	Asclepiadaceae	ASLA4	ASCLAT	–	–
4	broom milkwort	*Polygala scoparioides*	Polygalaceae	POSC2	POLSCO	Y	–
4	brownplume wirelettuce	*Stephanomeria pauciflora*	Asteraceae	STPA4	STEPAU	Y	–
4	buckwheat	*Eriogonum* spp.	Polygonaceae	ERIOG	ERIOGO	–	–
4	buffalo gourd	*Cucurbita foetidissima*	Cucurbitaceae	CUFO	CUCFOE	–	–
4	buffalobur nightshade	*Solanum rostratum*	Solanaceae	SORO	SOLROS	–	–
4	buffpetal	*Rhynchosida physocalyx*	Malvaceae	RHPH2	RHYPHY	Y	–
4	butterfly milkweed	*Asclepias tuberosa*	Asclepiadaceae	ASTU	ASCTUB	Y	–
4	butterfly milkweed	*Asclepias tuberosa* ssp. *interior*	Asclepiadaceae	ASTUI	ASCTUB	–	–
4	Canadian horseweed	*Conyza canadensis*	Asteraceae	COCA5	CONCAN	Y	–
4	cardinal beardtongue	*Penstemon cardinalis* ssp. *regalis*	Plantaginaceae	PECAR	PENCAR	Y	–
4	cardinalflower	*Lobelia cardinalis*	Campanulaceae	LOCA2	LOBCAR	Y	–
4	carrot family	Apiaceae	Apiaceae	APIACE	APIACE	–	–
4	chickenthief	*Mentzelia oligosperma*	Loasaceae	MEOL	MENOLI	–	–
4	Chihuahuan flax	*Linum vernale*	Linaceae	LIVE2	LINVER	Y	–
4	Chisos Mountain false Indianmallow	*Allowissadula holosericea*	Malvaceae	ALHO4	ALLHOL	Y	–
4	Cochise scaly cloakfern	*Astrolepis cochisensis*	Pteridaceae	ASCO42	ASTCOC	Y	GUMO-16633
4	collegeflower	*Hymenopappus flavescens* var. *canotomentosus*	Asteraceae	HYFLC	HYMFLA	Y	–
4	Colorado four o'clock	*Mirabilis multiflora*	Nyctaginaceae	MIMU	MIRMUL	Y	–
4	Colorado rubberweed	*Hymenoxys richardsonii* var. *floribunda*	Asteraceae	HYRIF	HYMRIC	Y	–
4	columbine	*Aquilegia* spp.	Ranunculaceae	AQUIL	AQUILE	–	–
4	common maidenhair	*Adiantum capillus-veneris*	Pteridaceae	ADCA	ADICAP	Y	–
4	common mullein	*Verbascum thapsus*	Scrophulariaceae	VETH	VERTHA	–	–
4	common purslane	*Portulaca oleracea*	Portulacaceae	POOL	POROLE	–	–

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4	common sunflower	*Helianthus* spp.	Asteraceae	HELIA3	HELIAN	–	–
4	common yarrow	*Achillea millefolium*	Asteraceae	ACMI2	ACHMIL	–	–
4	conyza	*Laennecia coulteri*	Asteraceae	LACO13	LAECOU	Y	–
4	cottonbatting cudweed	*Pseudognaphalium stramineum*	Asteraceae	PSST7	PSESTR	Y	–
4	Coulter's wrinklefruit	*Tetraclea coulteri*	Verbenaceae	TECO	TETCOU	Y	–
4	crestrib morningglory	*Ipomoea costellata*	Convolvulaceae	IPCO2	IPOCOS	Y	–
4	croton	*Croton* spp.	Euphorbiaceae	CROTO	CROTON	–	–
4	crowpoison	*Nothoscordum bivalve*	Liliaceae	NOBI2	NOTBIV	Y	–
4	Cuman ragweed	*Ambrosia psilostachya*	Asteraceae	AMPS	AMBPSI	–	–
4	Dakota mock vervain	*Glandularia bipinnatifida*	Verbenaceae	GLBI2	GLABIP	–	–
4	Dakota mock vervain	*Glandularia bipinnatifida* var. *bipinnatifida*	Verbenaceae	GLBIB	GLABIP	Y	GUMO-16640
4	David's spurge	*Euphorbia davidii*	Euphorbiaceae	EUDA5	EUPDAV	Y	GUMO-16599
4	desert holly	*Acourtia nana*	Asteraceae	ACNA2	ACONAN	Y	–
4	desert marigold	*Baileya multiradiata*	Asteraceae	BAMU	BAIMUL	Y	–
4	desert tobacco	*Nicotiana obtusifolia* var. *obtusifolia*	Solanaceae	NIOBO	NICOBT	–	–
4	desert zinnia	*Zinnia acerosa*	Asteraceae	ZIAC	ZINACE	Y	–
4	diamond-flowers	*Stenaria nigricans* var. *nigricans*	Rubiaceae	STNIN	STENIG	Y	–
4	dotted gayfeather	*Liatris punctata*	Asteraceae	LIPU	LIAPUN	–	–
4	Drummond's false pennyroyal	*Hedeoma drummondii*	Lamiaceae	HEDR	HEDDRU	Y	–
4	Drummond's skullcap	*Scutellaria drummondii*	Lamiaceae	SCDR2	SCUDRU	Y	–
4	Drummond's woodsorrel	*Oxalis drummondii*	Oxalidaceae	OXDR	OXADRU	Y	–
4	dwarf blue-eyed grass	*Sisyrinchium demissum*	Iridaceae	SIDE4	SISDEM	Y	GUMO-16605
4	dwarf false pennyroyal	*Hedeoma nana*	Lamiaceae	HENA	HEDNAN	Y	–
4	dwarf fameflower	*Phemeranthus brevicaulis*	Portulacaceae	PHBR15	PHEBRE	Y	–
4	dwarf prairieclover	*Dalea nana* var. *carnescens*	Fabaceae	DANAC	DALNANC	Y	–
4	early shaggytuft	*Stenandrium barbatum*	Acanthaceae	STBA	STEBAR	–	–
4	Eaton's lipfern	*Cheilanthes eatonii*	Pteridaceae	CHEA	CHEEAT	Y	–
4	Edwards Plateau five eyes	*Chamaesaracha edwardsiana*	Solanaceae	CHED	CHAMAE	Y	–
4	El Paso blazingstar	*Mentzelia saxicola*	Loasaceae	MESA2	MENSAX	Y	–
4	Emory's milkvetch	*Astragalus emoryanus*	Fabaceae	ASEM2	ASTEMO	Y	–

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4	Engelmann's daisy	*Engelmannia peristenia*	Asteraceae	ENPE4	ENGPER	–	–
4	eveningprimrose	*Oenothera* spp.	Onagraceae	OENOT	OENOTH	–	–
4	false pennyroyal	*Hedeoma* spp.	Lamiaceae	HEDEO	HEDEOM	–	–
4	false springparsley	*Pseudocymopterus* spp.	Apiaceae	PSEUD4	PSEUDO	–	–
4	Fendler's bladderpod	*Physaria fendleri*	Brassicaceae	LEFE	PHYFEN	Y	–
4	Fendler's globemallow	*Sphaeralcea fendleri*	Malvaceae	SPFE	SPHFEN	Y	–
4	Fendler's meadowrue	*Thalictrum fendleri*	Ranunculaceae	THFE	THAFEN	Y	–
4	Fendler's pennycress	*Noccaea fendleri* ssp. *fendleri*	Brassicaceae	NOMOF	NOCFEN	Y	–
4	Fendler's sandmat	*Chamaesyce fendleri*	Euphorbiaceae	CHFE3	CHAFEN	–	–
4	fetid goosefoot	*Chenopodium graveolens*	Chenopodiaceae	CHGR2	CHEGRA	Y	GUMO-16586
4	fetid marigold	*Dyssodia papposa*	Asteraceae	DYPA	DYSPAP	Y	–
4	field bindweed	*Convolvulus arvensis*	Convolvulaceae	COAR4	CONARV	Y	GUMO-16588
4	fineleaf fournerved daisy	*Tetraneuris linearifolia* var. *linearifolia*	Asteraceae	TELIL	TETLIN	Y	–
4	fire on the mountain	*Euphorbia cyathophora*	Euphorbiaceae	EUCY	EUPCYA	Y	–
4	five eyes	*Chamaesaracha* spp.	Solanaceae	CHAMA8	CHAMAE	–	–
4	five-flowered rockdaisy	*Perityle quinqueflora*	Asteraceae	PEQU	PERQUI	Y	–
4	fiveneedle pricklyleaf	*Thymophylla pentachaeta*	Asteraceae	THPE4	THYPEN	–	–
4	fiveneedle pricklyleaf	*Thymophylla pentachaeta* var. *belenidium*	Asteraceae	THPEB	THYPEN	Y	–
4	flameflower	*Talinum* spp.	Portulacaceae	TALIN2	TALINU	–	–
4	flatspine stickseed	*Lappula occidentalis*	Boraginaceae	LAOC3	LAPOCC	–	–
4	fleabane	*Erigeron* spp.	Asteraceae	ERIGE2	ERIGER	–	–
4	foothill sagewort	*Artemisia ludoviciana* ssp. *ludoviciana*	Asteraceae	ARLUL2	ARTLUD	Y	–
4	geranium	*Geranium* spp.	Geraniaceae	GERAN	GERANI	–	–
4	glandleaf milkwort	*Polygala macradenia*	Polygalaceae	POMA7	POLMAC	Y	–
4	globemallow	*Sphaeralcea* spp.	Malvaceae	SPHAE	SPHAER	–	–
4	golden crownbeard	*Verbesina encelioides*	Asteraceae	VEEN	VERENC	Y	–
4	goldenrod	*Solidago* spp.	Asteraceae	SOLID	SOLIDA	–	–
4	grassland croton	*Croton dioicus*	Euphorbiaceae	CRDI6	CRODIO	Y	–
4	gray five eyes	*Chamaesaracha coniodes*	Solanaceae	CHCO	CHACON	Y	–
4	gray globemallow	*Sphaeralcea incana*	Malvaceae	SPIN2	SPHINC	Y	GUMO-16607

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	Gray's feverfew	*Parthenium confertum* var. *lyratum*	Asteraceae	PACOL	PARCON	Y	–
4	green gromwell	*Lithospermum viride*	Boraginaceae	LIVI2	LITVIR	Y	–
4	greenleaf five eyes	*Chamaesaracha coronopus*	Solanaceae	CHCO2	CHACOR	Y	–
4	greenthread	*Thelesperma* spp.	Asteraceae	THELE	THELES	–	–
4	gromwell	*Lithospermum* spp.	Boraginaceae	LITHO3	LITHOS	–	–
4	groundsel	*Senecio* spp.	Asteraceae	SENEC	SENECI	–	–
4	Guadalupe blazingstar	*Mentzelia humilis* var. *guadalupensis*	Loasaceae	MEHUG	MENHUM	Y	–
4	Guadalupe milkvetch	*Astragalus pictiformis*	Fabaceae	ASPI3	ASTPIC	Y	–
4	Guadalupe milkwort	*Polygala rimulicola* var. *rimulicola*	Polygalaceae	PORIR	POLRIM	Y	–
4	gumweed	*Grindelia* spp.	Asteraceae	GRIND	GRINDE	–	–
4	gypsum blanketflower	*Gaillardia multiceps*	Asteraceae	GAMU	GAIMUL	Y	–
4	gypsum moonpod	*Acleisanthes lanceolata*	Nyctaginaceae	SELA3	SELLAN	Y	–
4	gypsum scorpionweed	*Phacelia integrifolia*	Hydrophyllaceae	PHIN	PHAINT	–	–
4	hairy five eyes	*Chamaesaracha sordida*	Solanaceae	CHSO	CHASOR	Y	–
4	hairy goldenaster	*Heterotheca villosa*	Asteraceae	HEVI4	HETVIL	–	–
4	hairyseed bahia	*Bahia absinthifolia*	Asteraceae	BAAB	BAHABS	Y	–
4	Hart's ragwort	*Packera hartiana*	Asteraceae	PAHA16	PACHAR	–	–
4	Hartweg's sundrops	*Calylophus hartwegii* ssp. *pubescens*	Onagraceae	CAHAP	CALHAR	Y	–
4	Havard's buckwheat	*Eriogonum havardii*	Polygonaceae	ERHA	ERIHAV	Y	–
4	hawkweed	*Hieracium* spp.	Asteraceae	HIERA	HIERAC	–	–
4	hawkweed buckwheat	*Eriogonum hieraciifolium*	Polygonaceae	ERHI3	ERIHIE	Y	–
4	heartleaf goldeneye	*Viguiera cordifolia*	Asteraceae	VICO	VIGCOR	Y	–
4	hedgehog pricklypoppy	*Argemone squarrosa*	Papaveraceae	ARSQ	ARGSQU	Y	–
4	hedgehog pricklypoppy	*Argemone squarrosa* ssp. *glabrata*	Papaveraceae	ARSQG	ARGSQU	Y	–
4	hiddenflower	*Cryptantha crassisepala*	Boraginaceae	CRCR3	CRYCRA	Y	–
4	hoary sandmat	*Chamaesyce lata*	Euphorbiaceae	CHLA10	CHALAT	Y	–
4	Hopi tea greenthread	*Thelesperma megapotamicum*	Asteraceae	THME	THEMEG	–	–
4	horehound	*Marrubium vulgare*	Lamiaceae	MAVU	MARVUL	Y	–
4	horned spurge	*Euphorbia brachycera*	Euphorbiaceae	EUBR	EUPBRA	Y	–
4	hybrid cloakfern	*Astrolepis integerrima*	Pteridaceae	ASIN19	ASTINT2	Y	GUMO-16634

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	hymenoxys	*Tetraneuris* spp.	Asteraceae	TETRA17	TETRAN	–	–
4	Indian mallow	*Abutilon* spp.	Malvaceae	ABUTI	ABUTIL	Y	–
4	Indian rushpea	*Hoffmannseggia glauca*	Fabaceae	HOGL2	HOFGLA	Y	–
4	Indianhemp	*Apocynum cannabinum*	Apocynaceae	APCA	APOCAN	–	–
4	ivyleaf groundcherry	*Physalis hederifolia* var. *comata*	Solanaceae	PHHEC	PHYHED	Y	–
4	ivyleaf groundcherry	*Physalis hederifolia* var. *hederifolia*	Solanaceae	PHHEH2	PHYHED	Y	–
4	James' beardtongue	*Penstemon jamesii*	Plantaginaceae	PEJA	PENJAM	Y	–
4	James' buckwheat	*Eriogonum jamesii*	Polygonaceae	ERJA	ERIJAM	–	–
4	James' nailwort	*Paronychia jamesii*	Caryophyllaceae	PAJA	PARJAM	Y	–
4	James' prairieclover	*Dalea jamesii*	Fabaceae	DAJA	DALJAM	Y	–
4	kiss me quick	*Portulaca pilosa*	Portulacaceae	POPI3	PORPIL	Y	GUMO-16630
4	Kunth's onion	*Allium kunthii*	Liliaceae	ALKU	ALLKUN	Y	–
4	lacy germander	*Teucrium laciniatum*	Lamiaceae	TELA	TEULAC	Y	–
4	lacy tansyaster	*Xanthisma spinulosum*	Asteraceae	MAPI	XANSPI2	–	–
4	lanceleaf sage	*Salvia reflexa*	Lamiaceae	SARE3	SALREF	Y	–
4	leatherweed	*Croton pottsii*	Euphorbiaceae	CRPO5	CROPOT	Y	–
4	limewater brookweed	*Samolus ebracteatus* ssp. *cuneatus*	Primulaceae	SAEBC	SAMEBR	Y	GUMO-16631
4	limpia blacksenna	*Seymeria scabra*	Orobanchaceae	SESC3	SEYSCA	Y	–
4	Lindheimer's morningglory	*Ipomoea lindheimeri*	Convolvulaceae	IPLI	IPOLIN	Y	–
4	longleaf cologania	*Cologania angustifolia*	Fabaceae	COAN	COLANG	Y	–
4	longstalk greenthread	*Thelesperma longipes*	Asteraceae	THLO	THELON	Y	–
4	lyreleaf greeneyes	*Berlandiera lyrata*	Asteraceae	BELY	BERLYR	Y	–
4	MacDougal verbena	*Verbena macdougalii*	Verbenaceae	VEMA	VERMAC	Y	–
4	manyflowered broomrape	*Orobanche ludoviciana* ssp. *multiflora*	Orobanchaceae	ORLUM	OROLUD	Y	–
4	manyflowered gromwell	*Lithospermum multiflorum*	Boraginaceae	LIMU3	LITMUL	Y	–
4	matted sandmat	*Chamaesyce serpens*	Euphorbiaceae	CHSE4	CHASER	–	–
4	McKittrick's Solomon's seal	*Polygonatum cobrense*	Liliaceae	POCO6	POLCOB	Y	–
4	mealy goosefoot	*Chenopodium incanum*	Chenopodiaceae	CHIN2	CHEINC	Y	–
4	mealycup sage	*Salvia farinacea*	Lamiaceae	SAFA2	SALFAR	Y	–
4	mentzelia	*Mentzelia* spp.	Loasaceae	MENTZ	MENTZE	–	–

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LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	mesa greggia	*Nerisyrenia camporum*	Brassicaceae	NECA3	NERCAM	Y	–
4	Mexican bedstraw	*Galium mexicanum* ssp. *asperrimum*	Rubiaceae	GAMEA	GALMEX	Y	GUMO-16651
4	Mexican campion	*Silene laciniata*	Caryophyllaceae	SILA2	SILLAC	Y	–
4	Mexican cancer-root	*Conopholis alpina* var. *mexicana*	Orobanchaceae	COALM	CONALP	Y	–
4	Mexican white sagebrush	*Artemisia ludoviciana* ssp. *mexicana*	Asteraceae	ARLUM2	ARTLUD	Y	–
4	milkvetch	*Astragalus* spp.	Fabaceae	ASTRA	ASTRAG	–	–
4	milkweed	*Asclepias* spp.	Asclepiadaceae	ASCLE	ASCLEP2	–	–
4	milkweed family	*Asclepiadaceae*	Asclepiadaceae	ASCLEP	ASCLEP	–	–
4	mint family	*Lamiaceae*	Lamiaceae	LAMIAC	LAMIAC	–	–
4	Missouri violet	*Viola missouriensis*	Violaceae	VIMI3	VIOMIS	Y	–
4	mountain pepperweed	*Lepidium alyssoides* var. *angustifolium*	Brassicaceae	LEALA4	LEPALY	Y	–
4	mustard	*Brassica* spp.	Brassicaceae	BRASS2	BRASSI	–	–
4	narrowleaf four o'clock	*Mirabilis linearis*	Nyctaginaceae	MILI3	MIRLIN	Y	–
4	narrowleaf goosefoot	*Chenopodium leptophyllum*	Chenopodiaceae	CHLE4	CHELEP	Y	–
4	narrowleaf gromwell	*Lithospermum incisum*	Boraginaceae	LIIN2	LITINC	–	–
4	narrowleaf pectis	*Pectis angustifolia*	Asteraceae	PEAN	PECANG	Y	–
4	needleleaf bluet	*Houstonia acerosa*	Rubiaceae	HOAC	HOUACE	–	–
4	needleleaf bluet	*Houstonia acerosa* var. *acerosa*	Rubiaceae	HOACA2	HOUACE	Y	GUMO-16636
4	needleleaf bluet	*Houstonia acerosa* var. *polypremoides*	Rubiaceae	HOACP2	HOUACE	Y	GUMO-16637
4	netted globecherry	*Margaranthus solanaceus*	Solanaceae	MASO4	MARSOL	Y	GUMO-16639
4	New Mexico copperleaf	*Acalypha neomexicana*	Euphorbiaceae	ACNE	ACANEO2	Y	–
4	New Mexico silverbush	*Argythamnia neomexicana*	Euphorbiaceae	ARNE2	ARGNEO	Y	–
4	nodding onion	*Allium cernuum*	Liliaceae	ALCE2	ALLCER	Y	–
4	onion	*Allium* spp.	Liliaceae	ALLIU	ALLIUM	–	–
4	orange flameflower	*Phemeranthus aurantiacus*	Portulacaceae	PHAU13	PHEAUR	Y	–
4	paintbrush	*Castilleja* spp.	Orobanchaceae	CASTI2	CASTIL	–	–
4	pale cologania	*Cologania pallida*	Fabaceae	COPA4	COLPAL	Y	–
4	pale eveningprimrose	*Oenothera pallida* ssp. *runcinata*	Onagraceae	OEPAR	OENPAL	Y	–
4	parasitic lady's tresses	*Schiedeella arizonica*	Orchidaceae	SCAR8	SCHARI	Y	–
4	Parry's sandmat	*Chamaesyce parryi*	Euphorbiaceae	CHPA28	CHAPAR	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	peavine	*Lathyrus* spp.	Fabaceae	LATHY	LATHYR	Y	–
4	phacelia	*Phacelia* spp.	Hydrophyllaceae	PHACE	PHACEL	Y	–
4	phlox	*Phlox* spp.	Polemoniaceae	PHLOX	PHLOX	–	–
4	pinesap	*Monotropa hypopithys*	Monotropaceae	MOHY3	MONHYP	Y	–
4	pineywoods geranium	*Geranium caespitosum*	Geraniaceae	GECA3	GERCAE	Y	–
4	pingue hymenoxys	*Hymenoxys richardsonii*	Asteraceae	HYRI	HYMRIC	–	–
4	pink alumroot	*Heuchera rubescens*	Saxifragaceae	HERU	HEURUB	Y	–
4	pinleaf vervain	*Verbena perennis*	Verbenaceae	VEPE	VERPER	Y	–
4	plains blackfoot	*Melampodium leucanthum*	Asteraceae	MELE2	MELLEU	Y	–
4	plains dozedaisy	*Aphanostephus ramosissimus*	Asteraceae	APRA	APHRAM	Y	–
4	plains flax	*Linum puberulum*	Linaceae	LIPU4	LINPUB	Y	GUMO-16606
4	plumed brickellbush	*Brickellia brachyphylla*	Asteraceae	BRBR2	BRIBRA	Y	–
4	pointed sandmat	*Chamaesyce acuta*	Euphorbiaceae	CHAC2	CHAACU	Y	GUMO-16596
4	potato family	Solanaceae	Solanaceae	SOLANA	SOLANA	–	–
4	prairie flax	*Linum lewisii*	Linaceae	LILE3	LINLEW	–	–
4	prairieclover	*Dalea* spp.	Fabaceae	DALEA	DALEA	–	–
4	prickly Russian thistle	*Salsola tragus*	Chenopodiaceae	SATR12	SALTRA	Y	–
4	purple cliffbrake	*Pellaea atropurpurea*	Pteridaceae	PEAT2	PELATR	Y	–
4	purple sand verbena	*Abronia angustifolia*	Nyctaginaceae	ABAN	ABRANG	Y	–
4	ragleaf bahia	*Bahia dissecta*	Asteraceae	BADI	BAHDIS	–	–
4	ragwort	*Packera* spp.	Asteraceae	PACKE	PACKER	Y	–
4	red cyphomeris	*Cyphomeris gypsophiloides*	Nyctaginaceae	CYGY	CYPGYP	Y	–
4	red dome blanketflower	*Gaillardia pinnatifida*	Asteraceae	GAPI	GAIPIN	Y	–
4	redroot pigweed	*Amaranthus retroflexus*	Amaranthaceae	AMRE	AMARET	Y	–
4	redstem stork's bill	*Erodium cicutarium*	Geraniaceae	ERCI6	EROCIC	–	–
4	resurrection plant	*Selaginella pilifera*	Selaginellaceae	SEPI	SELPIL	Y	–
4	ribbed false pennyroyal	*Hedeoma costata* var. *pulczhella*	Lamiaceae	HECOP	HEDCOS	Y	–
4	ribseed sandmat	*Chamaesyce glyptosperma*	Euphorbiaceae	CHGL13	CHAGLY	Y	–
4	Rocky Mountain zinnia	*Zinnia grandiflora*	Asteraceae	ZIGR	ZINGRA	Y	–
4	rockyscree falsegoldenaster	*Heterotheca fulcrata*	Asteraceae	HEFU3	HETFUL	Y	–

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LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	rockyscree falsegoldenaster	*Heterotheca fulcrata* var. *fulcrata*	Asteraceae	HEFUF	HETFUL	Y	–
4	rose bladderpod	*Physaria purpurea*	Brassicaceae	LEPU2	PHYPUR	Y	–
4	rose heath	*Chaetopappa ericoides*	Asteraceae	CHER2	CHAERI	Y	–
4	rough cocklebur	*Xanthium strumarium*	Asteraceae	XAST	XANSTR	–	–
4	roundleaf snakeweed	*Gutierrezia sphaerocephala*	Asteraceae	GUSP	GUTSPH	Y	–
4	roving sailor	*Maurandella antirrhiniflora*	Plantaginaceae	MAAN9	MAUANT	Y	–
4	rubberweed	*Hymenoxys* spp.	Asteraceae	HYMEN7	HYMENO	–	–
4	rue of the mountains	*Thamnosma texana*	Rutaceae	THTE2	THATEX	–	–
4	sand fiddleleaf	*Nama carnosum*	Hydrophyllaceae	NACA	NAMCAR	Y	–
4	sanddune wallflower	*Erysimum capitatum*	Brassicaceae	ERCA14	ERYCAP	Y	–
4	sandmat	*Chamaesyce* spp.	Euphorbiaceae	CHAMA15	CHAMAE2	–	–
4	sawtooth sandmat	*Chamaesyce serrula*	Euphorbiaceae	CHSE7	CHASER3	Y	GUMO-16597
4	scarlet beeblossom	*Gaura coccinea*	Onagraceae	GACO5	GAUCOC	–	–
4	scarlet globemallow	*Sphaeralcea coccinea*	Malvaceae	SPCO	SPHCOC	–	–
4	scarlet skyrocket	*Ipomopsis aggregata* ssp. *formosissima*	Polemoniaceae	IPAGF	IPOAGG	Y	–
4	Schied's flax	*Linum schiedeanum*	Linaceae	LISC5	LINSCH	Y	–
4	shaggy dwarf morningglory	*Evolvulus nuttallianus*	Convolvulaceae	EVNU	EVONUT	Y	–
4	shortfruit eveningprimrose	*Oenothera brachycarpa*	Onagraceae	OEBR	OENBRA	Y	–
4	showy frasera	*Frasera speciosa*	Gentianaceae	FRSP	FRASPE	Y	–
4	showy goldeneye	*Heliomeris multiflora*	Asteraceae	HEMU3	HELMUL	–	–
4	shrubby copperleaf	*Acalypha phleoides*	Euphorbiaceae	ACPH3	ACAPHL	Y	–
4	silky phacelia	*Phacelia rupestris*	Hydrophyllaceae	PHRU2	PHARUP	Y	GUMO-16604
4	silver dwarf morningglory	*Evolvulus sericeus*	Convolvulaceae	EVSE	EVOSER	Y	GUMO-16589
4	silverleaf nightshade	*Solanum elaeagnifolium*	Solanaceae	SOEL	SOLELA	Y	–
4	skyrocket gilia	*Ipomopsis aggregata*	Polemoniaceae	IPAG	IPOAGG	–	–
4	slender lipfern	*Cheilanthes feei*	Pteridaceae	CHFE	CHEFEE	Y	–
4	slimleaf plainsmustard	*Schoenocrambe linearifolia*	Brassicaceae	SCLI12	SCHLIN	Y	–
4	slimlobe globeberry	*Ibervillea tenuisecta*	Cucurbitaceae	IBTE2	IBETEN	–	–
4	slimseed sandmat	*Chamaesyce stictospora*	Euphorbiaceae	CHST8	CHASTI	Y	GUMO-16598
4	small rocklettuce	*Pinaropappus parvus*	Asteraceae	PIPA	PINPAR	Y	–

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4	smallleaf falsecloak fern	*Argyrochosma microphylla*	Pteridaceae	ARMI6	ARGMIC	Y	–
4	smartweed leafflower	*Phyllanthus polygonoides*	Euphorbiaceae	PHPO3	PHYPOL	Y	–
4	smooth horsetail	*Equisetum laevigatum*	Equisetaceae	EQLA	EQULAE	Y	–
4	smooth spreading four o'clock	*Mirabilis oxybaphoides*	Nyctaginaceae	MIOX	MIROXY	Y	–
4	southern cattail	*Typha domingensis*	Typhaceae	TYDO	TYPDOM	Y	–
4	southern flax	*Linum australe* var. *australe*	Linaceae	LIAUA	LINAUS	Y	–
4	southwestern falsecloak fern	*Argyrochosma limitanea*	Pteridaceae	ARLI4	ARGLIM	–	–
4	southwestern falsecloak fern	*Argyrochosma limitanea* ssp. *mexicana*	Pteridaceae	ARLIM	ARGLIM	Y	GUMO-16632
4	spear globemallow	*Sphaeralcea hastulata*	Malvaceae	SPHA	SPHHAS	–	–
4	spectacle pod	*Dimorphocarpa wislizeni*	Brassicaceae	DIWI2	DIMWIS	–	–
4	spider milkweed	*Asclepias asperula*	Asclepiadaceae	ASAS	ASCASP	–	–
4	spider milkweed	*Asclepias asperula* ssp. *asperula*	Asclepiadaceae	ASASA	ASCASP	Y	GUMO-16577
4	spiderling	*Boerhavia* spp.	Nyctaginaceae	BOERH2	BOERHA	–	–
4	spikemoss	*Selaginella* spp.	Selaginellaceae	SELAG	SELAGI	–	–
4	splitleaf gilia	*Giliastrum incisum*	Polemoniaceae	GIIN6	GILINC2	Y	GUMO-16629
4	spreading fanpetals	*Sida abutifolia*	Malvaceae	SIAB	SIDABU	Y	–
4	spreading fleabane	*Erigeron divergens*	Asteraceae	ERDI4	ERIDIV	Y	–
4	spurge	*Euphorbia* spp.	Euphorbiaceae	EUPHO	EUPHOR	–	–
4	squareseed spurge	*Euphorbia exstipulata*	Euphorbiaceae	EUEX4	EUPEXS	Y	GUMO-16600
4	stemless four-nerve daisy	*Tetraneuris acaulis* var. *acaulis*	Asteraceae	TEACA2	TETACA	Y	–
4	stemmy four-nerve daisy	*Tetraneuris scaposa*	Asteraceae	TESC2	TETSCA	–	–
4	stemmy four-nerve daisy	*Tetraneuris scaposa* var. *scaposa*	Asteraceae	TESCS	TETSCA	Y	–
4	stickseed	*Hackelia* spp.	Boraginaceae	HACKE	HACKEL	–	–
4	stinging serpent	*Cevallia sinuata*	Loasaceae	CESI	CEVSIN	Y	–
4	stonecrop	*Sedum* spp.	Crassulaceae	SEDUM	SEDUM	–	–
4	strawberry	*Fragaria* spp.	Rosaceae	FRAGA	FRAGAR	–	–
4	summer coralroot	*Corallorhiza maculata*	Orchidaceae	COMA25	CORMAC	–	–
4	tall morningglory	*Ipomoea purpurea*	Convolvulaceae	IPPU2	IPOPUR	Y	GUMO-16591
4	tanseyleaf aster	*Machaeranthera tanacetifolia*	Asteraceae	MATA2	MACTAN	–	–
4	tansymustard	*Descurainia* spp.	Brassicaceae	DESCU	DESCUR	–	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	Texas bindweed	*Convolvulus equitans*	Convolvulaceae	COEQ	CONEQU	Y	–
4	Texas crested coralroot	*Hexalectris warnockii*	Orchidaceae	HEWA	HEXWAR	Y	–
4	Texas feathershank	*Schoenocaulon texanum*	Liliaceae	SCTE2	SCHTEX	Y	–
4	Texas filaree	*Erodium texanum*	Geraniaceae	ERTE13	EROTEX	–	–
4	Texas skeletonplant	*Lygodesmia texana*	Asteraceae	LYTE	LYGTEX	Y	–
4	Texas snoutbean	*Rhynchosia senna* var. *texana*	Fabaceae	RHSET	RHYSEN	Y	–
4	Texas tansyaster	*Xanthisma blephariphyllum*	Asteraceae	MABL2	XANBLE	Y	–
4	thistle	Cirsium spp.	Asteraceae	CIRSI	CIRSIU	–	–
4	threadleaf glowwort	*Sartwellia flaveriae*	Asteraceae	SAFL5	SARFLA	Y	GUMO-16585
4	threadleaf ragwort	*Senecio flaccidus* var. *flaccidus*	Asteraceae	SEFLF	SENFLA	Y	–
4	threadstem sandmat	*Chamaesyce revoluta*	Euphorbiaceae	CHRE4	CHAREV	Y	–
4	threeseed croton	*Croton lindheimerianus*	Euphorbiaceae	CRLI2	CROLIN	Y	–
4	threeseed phlox	*Phlox triovulata*	Polemoniaceae	PHTR	PHLTRI	Y	–
4	thymeleaf sandmat	*Chamaesyce serpyllifolia*	Euphorbiaceae	CHSE6	CHASER2	Y	–
4	toothleaf goldeneye	*Viguiera dentata*	Asteraceae	VIDE3	VIGDEN	Y	–
4	Torrey's craglily	*Echeandia flavescens*	Liliaceae	ECFL	ECHFLA	Y	–
4	trailing fleabane	*Erigeron flagellaris*	Asteraceae	ERFL	ERIFLA	Y	–
4	trailing krameria	*Krameria lanceolata*	Krameriaceae	KRLA	KRALAN	Y	–
4	trailing windmills	*Allionia incarnata*	Nyctaginaceae	ALIN	ALLINC	Y	–
4	Trans-Pecos giant hyssop	*Agastache breviflora*	Lamiaceae	AGBR	AGABRE	Y	–
4	Trans-Pecos Indian parsley	*Aletes filifolius*	Apiaceae	ALFI3	ALEFIL	Y	–
4	Trans-Pecos morningglory	*Ipomoea cristulata*	Convolvulaceae	IPCR	IPOCRI	Y	GUMO-16590
4	trumpet morning glory	*Ipomoea tenuiloba*	Convolvulaceae	IPTE	IPOTEN	Y	–
4	tuber starwort	*Pseudostellaria jamesiana*	Caryophyllaceae	PSJA2	PSEJAM	Y	–
4	twinpod	*Physaria* spp.	Brassicaceae	PHYSA2	PHYSAR	–	–
4	twoleaf wild sensitive plant	*Senna roemeriana*	Fabaceae	SERO8	SENROE	Y	–
4	unidentified forb	unidentified forb	unknown	2FORB	UNIDF	Y	–
4	unidentified forb - seedling	unidentified forb - seedling	unknown	2FA	UNIDF	–	–
4	upright prairie coneflower	*Ratibida columnifera*	Asteraceae	RACO3	RATCOL	–	–
4	Velvet bundleflower	*Desmanthus velutinis*	Fabaceae	DEVE2	DESVEL	Y	–

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	vetch	*Vicia* spp.	Fabaceae	VICIA	VICIA	–	–
4	villous lipfern	*Cheilanthes villosa*	Pteridaceae	CHVI	CHEVIL	Y	–
4	Violet	*Viola* spp.	Violaceae	VIOLA	VIOLA	–	–
4	wavy scaly cloakfern	*Astrolepis sinuata*	Pteridaceae	ASSI9	ASTSIN	Y	–
4	wavyleaf thistle	*Cirsium undulatum*	Asteraceae	CIUN	CIRUND	Y	–
4	wavyleaf twinevine	*Funastrum crispum*	Asclepiadaceae	FUCR	FUNCRI	Y	–
4	white four o'clock	*Mirabilis albida*	Nyctaginaceae	MIAL4	MIRABI	–	–
4	white milkwort	*Polygala alba*	Polygalaceae	POAL4	POLALB	Y	–
4	white rocklettuce	*Pinaropappus roseus*	Asteraceae	PIRO	PINROS	Y	–
4	white sagebrush	*Artemisia ludoviciana*	Asteraceae	ARLU	ARTLUD	Y	–
4	White Sands fanmustard	*Nerisyrenia linearifolia*	Brassicaceae	NELI	NERLIN	Y	–
4	whitemargin pussytoes	*Antennaria marginata*	Asteraceae	ANMA5	ANTMAR	Y	–
4	whitemouth dayflower	*Commelina erecta*	Commelinaceae	COER	COMERE	Y	–
4	wholeleaf Indian paintbrush	*Castilleja integra*	Orobanchaceae	CAIN14	CASINT	Y	–
4	wild tarragon	*Artemisia dracunculus*	Asteraceae	ARDR4	ARTDRA	–	–
4	wishbone fiddleleaf	*Nama dichotomum*	Hydrophyllaceae	NADI	NAMDIC	Y	GUMO-16603
4	woodland strawberry	*Fragaria vesca*	Rosaceae	FRVE	FRAVES	Y	–
4	woodsorrel	*Oxalis* spp.	Oxalidaceae	OXALI	OXALIS	–	–
4	woolly marsh elder	*Leuciva dealbata*	Asteraceae	LEDE23	LEUDEA	Y	–
4	woolly paperflower	*Psilostrophe tagetina*	Asteraceae	PSTA	PSITAG	Y	–
4	woolly plantain	*Plantago patagonica*	Plantaginaceae	PLPA2	PLAPAT	–	–
4	woolly prairieclover	*Dalea lanata* var. *terminalis*	Fabaceae	DALAT	DALLAN	Y	–
4	wooly tidestromia	*Tidestromia lanuginosa*	Amaranthaceae	TILA2	TIDLAN	Y	–
4	Wright's amaranth	*Amaranthus wrightii*	Amaranthaceae	AMWR	AMAWRI	Y	–
4	Wright's bedstraw	*Galium wrightii*	Rubiaceae	GAWR2	GALWRI2	Y	–
4	Wright's cudweed	*Pseudognaphalium canescens*	Asteraceae	PSCA11	PSECAN	Y	GUMO-16583
4	Wright's goldenrod	*Solidago wrightii* var. *guadalupensis*	Asteraceae	SOWR	SOLWRI	Y	–
4	Wright's prairieclover	*Dalea wrightii*	Fabaceae	DAWR	DALWRI	Y	GUMO-16601
4	Wright's spiderwort	*Tradescantia wrightii*	Commelinaceae	TRWR	TRAWRI	Y	–
4	Wright's spikemoss	*Selaginella wrightii*	Selaginellaceae	SEWR2	SELWRI	Y	GUMO-16638

Table A2 (continued). Species list for Guadalupe Mountains National Park, ordered by lifeform and common name. Lifeform code (LFC): 1 = tree, 2 = shrub, 2.5 = dwarf shrub, 3 = graminoid, 4 = forb.

LFC	Common Name	Species Name	Family	PLANTS Code	NHNM Acronym	Voucher	Park-NPS Catalog
4	Wright's stonecrop	*Sedum wrightii*	Crassulaceae	SEWR	SEDWRI	Y	–
4	Wright's thelypody	*Thelypodium wrightii*	Brassicaceae	THWR	THEWRI	Y	–
4	yellow hawkweed	*Hieracium fendleri*	Asteraceae	HIFE	HIEFEN	Y	–
4	yellowseed fiddleleaf	*Nama xylopodum*	Hydrophyllaceae	NAXY	NAMXYL	Y	–
–	cactus family	Cactaceae	Cactaceae	CACTAC	CACTAC	–	–
–	sunflower family	Asteraceae	Asteraceae	ASTERA	ASTERA	–	–

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Appendix B. Keys to Guadalupe Mountains National Park Plant Associations

The dichotomous keys to plant associations of Guadalupe Mountains National Park (NP) below use either explicitly specified cover values for indicator species as part of the decision rules in each step or specific adjectives that relate to species canopy cover as shown in Table B1. There are separate keys for the major classes (e.g., forests and woodlands, shrublands, etc.) as specified in the first key. Descriptions for each association can be found in Appendix C.

Table B1. Text descriptors for canopy cover and density with associated quantitative ranges definitions.

Descriptor	Definition
Absent	Individuals are not found in stand.
Present	Individuals found in stand.
Accidental/Incidental	Individuals very infrequent, occasional, or limited to special microsites.
Scarce/Scattered (uncommon)	Canopy coverage < 1%.
Common	Canopy coverage > 1%.
Poorly Represented	Canopy coverage < 5%.
Well Represented	Canopy coverage > 5%, but < 10%.
Abundant	Canopy coverage > 10%, but < 25%.
Very Abundant	Canopy coverage > 25%, but < 50%.
Luxuriant	Canopy coverage > 50%.
Dominant	Cover is greater than any other species of the same life form.
Codominant	Cover is as great as any other species of the same life form.
Regeneration	Understory trees represented by established seedlings and/or saplings.

Key to Major Vegetation Types

1a Trees dominant, typically > 25% canopy cover; or if < 25%, clearly the dominant and/or the characteristic growth form:. . . . . **KEY 1: Forests and Woodlands**

1b Trees < 10%, clearly not dominant:. **2**

2a (1b) Shrubs > 25%, or if < 25%, clearly the dominant and/or the characteristic growth form: . . . . . **KEY 2: Shrublands**

2b Shrubs usually < 25%, herbs clearly the dominant and/or characteristic growth form: . . . . . **KEY 3: Herbaceous Vegetation**

KEY 1: Forests and Woodlands

Key to Subtypes:

1a Forest and woodlands dominated by tall conifers and broadleaf trees that include *Pseudotsuga menziesii*, *Pinus strobiformis*, *Pinus ponderosa*, *Acer grandidentatum*, *Quercus muehlenbergii*, and/or *Populus deltoides*: . . . . . **Subkey 1A: Forests**

1b Woodlands dominated by short-statured conifer and broadleaf trees that include *Pinus edulis*, *Juniperus deppeana*, and *Quercus grisea*: . . . . . **Subkey 1B: Pinyon-Juniper-Oak Woodlands**

Subkey 1A: Forests

1a The conifers *Pseudotsuga menziesii*, *Pinus strobiformis*, and/or *Pinus ponderosa* dominate or codominate the overstory; broadleaf trees may be common in the subcanopy: **2**

1b The broadleaf trees *Acer grandidentatum*, *Quercus muehlenbergii* or *Populous deltoides* dominate or codominate the overstory; conifers minor, clearly subordinate or absent from the canopy: 23

2a (1a) *Pseudotsuga menziesii* dominant or codominant with *Pinus strobiformis* and/or *Pinus ponderosa*: 3

2b *Pseudotsuga menziesii* absent or accidental: 11

3a (2a) *Acer grandidentatum* well represented: 4

3b *Acer grandidentatum* poorly represented or absent: 6

4a (3a) *Quercus muehlenbergii* well represented: . . . . . ***Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii* Forest**

4b *Quercus muehlenbergii* absent or accidental: 5

5a (4b) *Ostrya knowltonii* well represented in the subcanopy: . . . . . ***Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii* Forest**

5b *Quercus gambelii* well represented in the subcanopy: . . . . . ***Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii* Forest**

6a (3b) *Ostrya knowltonii* well represented: . . . . . ***Pseudotsuga menziesii - Ostrya knowltonii* Forest**

6b *Ostrya knowltonii* absent or accidental: 7

7a (6b) *Pinus strobiformis* well represented: . . . . . ***Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest**

7b *Pinus strobiformis* absent or accidental: 8

8a (7b) *Quercus gambelii* well represented with grassy understory: 9

8b *Quercus gambelii* absent or accidental: . . . . . ***Pseudotsuga menziesii / Muhlenbergia pauciflora* Forest**

9a (8a) *Muhlenbergia pauciflora* well represented to luxuriant in the understory: . . . . . ***Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora*** **Forest**

9b *Muhlenbergia pauciflora* absent or accidental: **10**

10a (9b) *Piptochaetium fimbriatum* well represented to luxuriant in the understory: . . . . . ***Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum*** **Forest**

10b *Festuca arizonica* well represented in the understory: . . . . . ***Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica*** **Forest**

11a (2b) *Pinus strobiformis* dominant; *Pinus ponderosa* and *Pseudotsuga menziesii* clearly subordinate:. **12**

11b *Pinus ponderosa* dominant; *Pinus strobiformis* and *Pseudotsuga menziesii* subordinate, absent, or accidental: **17**

12a (11a) *Acer grandidentatum* well represented: **13**

12b *Acer grandidentatum* poorly represented or absent: **15**

13a (12a) *Quercus muehlenbergii* well represented: . . . . . ***Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii*** **Forest**

13b *Quercus muehlenbergii* absent or accidental: **14**

14a (13b) *Ostrya knowltonii* well represented in the subcanopy: . . . . . ***Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii*** **Forest**

14b *Quercus gambelii* well represented in the subcanopy: . . . . . ***Pinus strobiformis - Acer grandidentatum - Quercus gambelii*** **Forest**

15a (12b) *Quercus muehlenbergii* well represented: . . . . . .***Pinus strobiformis - Quercus muehlenbergii*** **Forest**

15b *Quercus muehlenbergii* absent or accidental: **16**

16a (15b) *Populus tremuloides* well represented:. . . . . .***Populus tremuloides - Pinus strobiformis / Ostrya knowltonii*** **Forest**

16b *Festuca arizonica* well represented to luxuriant in the understory: . . . . . ***Pinus strobiformis / Festuca arizonica*** **Forest**

17a (12b) *Acer grandidentatum* and/or *Quercus muehlenbergii* dominant or codominant:. . . . . ***Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii*** **Forest**

17b *Acer grandidentatum* and/or *Quercus muehlenbergii* absent or accidental:. **18**

18a (17b) *Quercus gambelii* well represented:. **19**

18b *Quercus gambelii* absent or accidental:. **20**

19a (18a) *Festuca arizonica* well represented to luxuriant; dominant in the understory: . . . . . ***Pinus ponderosa - Quercus gambelii / Festuca arizonica*** **Forest**

19b *Piptochaetium fimbriatum* well represented to luxuriant; dominant in the understory: . . . . . ***Pinus ponderosa / Quercus gambelii / Piptochaetium fimbriatum*** **Forest**

20a (18b) *Quercus* x *pauciloba* well represented: **21**

20b *Quercus* x *pauciloba* absent or accidental: **22**

21a (20a) *Muhlenbergia pauciflora* well represented to luxuriant; dominant in the understory: . . . . . ***Pinus ponderosa / Quercus*** x ***pauciloba / Muhlenbergia pauciflora*** **Forest**

21b *Piptochaetium fimbriatum* well represented to luxuriant; dominant in the understory: . . . . . ***Pinus ponderosa / Quercus*** **x** ***pauciloba / Piptochaetium fimbriatum*** **Forest**

22a (20b) *Muhlenbergia pauciflora* well represented to luxuriant in the understory: . . . . . ***Pinus ponderosa / Muhlenbergia pauciflora*** **Forest**

22b *Muhlenbergia pauciflora* uncommon or absent: . . . . . **unclassified conifer forest**

23a (1b) *Acer grandidentatum* dominant or codominant: **24**

23b *Populus deltoides* dominant in the canopy; *Acer grandidentatum* and/or *Quercus muehlenbergii* absent or accidental: . . . . . ***Populus deltoides / Muhlenbergia asperifolia*** **Flooded Forest**

24a (23a) *Quercus muehlenbergii* codominant in the canopy: . . . . . ***Acer grandidentatum - Quercus muehlenbergii*** **Forest**

24b *Quercus muehlenbergii* absent or accidental in the canopy: **25**

25a (24b) *Quercus gambelii* codominant in the canopy: . . . . . ***Acer grandidentatum / Quercus gambelii*** **Forest**

25b *Quercus grisea* codominant in the canopy. *Quercus gambelii* absent or accidental in the canopy: . . . . . ***Acer grandidentatum - Quercus grisea*** **Forest**

Subkey 1B: Pinyon - Juniper - Oak Woodlands

1a *Pinus edulis* well represented to abundant and the dominant or codominant in the canopy (>25% of the total tree cover) (i.e., relative to *Juniperus* and *Quercus* spp.): **2**

1b *Pinus edulis* absent or accidental in the canopy (<25% of the total tree cover) (i.e., relative to *Juniperus* and *Quercus* spp.): **7**

2a (1a) *Quercus* x *pauciloba* well represented to abundant and the dominant or codominant with *Cercocarpus montanus* var. *paucidentatus* in the subcanopy or shrub layer. *Muhlenbergia pauciflora* often well represented in the herbaceous layer. . . . . ***Pinus edulis / Quercus x pauciloba (Cercocarpus montanus*** **var.** ***paucidentatus) / Muhlenbergia pauciflora*** **Woodland**

2b *Quercus* x *pauciloba* poorly represented, incidental, or absent:. **3**

3a (2b) *Piptochaetium fimbriatum* well represented and dominant in the understory and intertree spaces:. . . . . ***Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum* Woodland**

3b *Piptochaetium fimbriatum* poorly represented, incidental, or absent: **4**

4a (3b) *Nassella tenuissima* well represented and dominant in the understory and intertree spaces: . . . . . ***Pinus edulis / Nassella tenuissima* Woodland**

4b *Nassella tenuissima* poorly represented, incidental, or absent: **5**

5a (4b) *Muhlenbergia setifolia* well represented and dominant in the understory and intertree spaces: . . . . . ***Pinus edulis / Muhlenbergia setifolia* Woodland**

5b *Muhlenbergia setifolia* poorly represented, incidental, or absent: **6**

6a (5b) *Muhlenbergia pauciflora* well represented and dominant in the understory and intertree spaces: . . . . . ***Pinus edulis / Muhlenbergia pauciflora* Woodland**

6b *Bouteloua gracilis* well represented and dominant in the understory and intertree spaces; *Muhlenbergia pauciflora* poorly represented, incidental, or absent:. . . . . ***Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis* Open Woodland**

7a (1b) *Quercus grisea* well represented to abundant and the dominant or codominant in the tree canopy (>25% of the total tree cover) (i.e., relative to *Juniperus deppeana*); or can be shrub-like following fires but still codominant with *Juniperus deppeana*: **8**

7b *Quercus grisea* absent or accidental in the tree canopy. Shrub-statured *Quercus grisea* may be present to well represented in the understory and intertree spaces. **11**

8a (7a) *Arbutus xalapensis* well represented in the subcanopy; grasses scattered and poorly represented: . . . . . ***Quercus grisea - Arbutus xalapensis* Woodland**

8b *Arbutus xalapensis* poorly represented, incidental, or absent; grasses well represented to abundant: **9**

9a (8b) *Muhlenbergia emersleyi* dominates the understory an intertree spaces:. . . . . ***Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi - (Bouteloua* spp.) Woodland**

9b *Muhlenbergia emersleyi* uncommon or absent:. **10**

10a (9b) *Piptochaetium fimbriatum* well represented and dominant in the understory and intertree spaces:. . . . . ***Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum* Woodland**

10b *Muhlenbergia pauciflora* well represented and dominant in the understory and intertree spaces; *Piptochaetium fimbriatum* poorly represented, incidental, or absent:. . . . . ***Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora* Woodland**

11a (7b) Shrubby *Quercus* x *pauciloba, Quercus pungens,* and/or shrub-statured *Quercus grisea* well represented in the understory and intertree spaces; *Bouteloua curtipendula* is frequently present to abundant. . . . . ***Juniperus deppeana* / *Quercus* x *pauciloba* / *Bouteloua curtipendula* Woodland**

11b *Quercus* x *pauciloba*, *Quercus pungens*, or shrub-statured *Quercus grisea* poorly represented or absent: **12**

12a (11b) *Bouteloua gracilis* dominates the understory and intertree spaces: . . . . . ***Juniperus deppeana* / *Bouteloua gracilis* Woodland**

12b *Muhlenbergia pauciflora* dominates the understory and intertree spaces:. . . . . ***Juniperus deppeana* / *Muhlenbergia pauciflora* Woodland**

KEY 2: Shrublands

Key to Subtypes:

1a Shrublands dominated by montane and foothill shrubs including *Quercus gambelii, Quercus* x *pauciloba*, *Quercus pungens*, shrub-statured *Quercus grisea, Cercocarpus montanus, Juniperus pinchotii*, and/or *Robinia neomexicana*. . . . . **Subkey 1A: Montane and Foothill Shrublands**

1b Shrublands dominated by desert shrubs that include *Acacia neovernicosa, Atriplex canescens, Chilopsis linearis, Fallugia paradoxa, Flourensia cernua, Larrea tridentata, Juglans microcarpa, Mimosa aculeaticarpa* var. b*iuncifera, Mortonia scabrella, Prosopis glandulosa, Psorothamnus scoparius, Sartwellia flaveriae, Tiquilia greggii*, and *Viguiera stenoloba*, among others: . . . . . **Subkey 1B: Desert Shrublands**

Subkey 2A: Montane and Foothill Shrublands

1a *Quercus* x *pauciloba, Quercus pungens*, shrub-statured *Quercus grisea*, *Cercocarpus montanus*, and/or *Juniperus pinchotii*, dominate the shrub layer: **2**

1b *Quercus gambelii* or *Robinia neomexicana* the dominant shrubs: **11**

2a (1a) *Juniperus pinchotii* well represented, often codominant with shrubby *Quercus* spp. The herbaceous layer is grassy and dominated by *Muhlenbergia setifolia:* . . . . . ***Juniperus pinchotii* / *Quercus* (*pungens,* x *pauciloba*) / *Muhlenbergia setifolia* Woodland**

2b *Juniperus pinchotii* uncommon or absent:. **3**

3a (2b) *Quercus* x *pauciloba, Quercus pungens*, or shrub-statured *Quercus grisea* dominant or codominant with *Cercocarpus montanus*:. **4**

3b *Cercocarpus montanus* the dominant shrub; *Quercus* x *pauciloba, Quercus pungens*, or shrub-statured *Quercus grisea* clearly subordinate, poorly represented or absent: **9**

4a (3a) Shrub understory and intershrub spaces dominated or codominated by *Achnatherum lobatum*: . . . . . ***Quercus* (x *pauciloba, pungens*) / *Achnatherum lobatum* Shrubland**

4b *Achnatherum lobatum* uncommon or absent:. **5**

5a (4b) Shrub understory and intershrub spaces dominated or codominated by *Muhlenbergia emersleyi*: ..... ***Quercus* (*pungens*, x *pauciloba*) / *Muhlenbergia emersleyi* Shrubland**

5b *Muhlenbergia emersleyi* uncommon or absent:..... **6**

6a (5b) Shrub understory and intershrub spaces dominated by *Muhlenbergia setifolia*: ..... ***Quercus pungens* / *Muhlenbergia setifolia* Shrubland**

6b *Muhlenbergia setifolia* uncommon or absent:..... **7**

7a (6b) Shrub understory and intershrub spaces dominated by *Muhlenbergia pauciflora*: ..... ***Quercus* (*pungens*, x *pauciloba*) / *Muhlenbergia pauciflora* Shrubland**

7b *Muhlenbergia pauciflora* uncommon or absent:..... **8**

8a (7b) Shrub understory and intershrub spaces dominated by *Bouteloua gracilis*:..... ***Quercus pungens* / *Bouteloua gracilis* Shrubland**

8b *Bouteloua gracilis* absent, other grasses generally sparse and scattered; *Cercocarpus montanus* clear codominant shrub creating as dense shrub layer:..... ***Quercus* x *pauciloba* / *Cercocarpus montanus* Shrubland**

9a (3b) Shrub understory and intershrub spaces dominated by *Muhlenbergia pauciflora*: ..... ***Cercocarpus montanus* / *Muhlenbergia pauciflora* Shrubland**

9b Shrub understory and intershrub spaces dominated by *Muhlenbergia setifolia*: ..... ***Cercocarpus montanus* / *Muhlenbergia setifolia* Shrubland**

10a (1b) *Quercus gambelii* the dominant shrub; *Robinia neomexicana* codominant or absent:..... **11**

10b *Quercus gambelii* poorly represented or absent:..... **13**

11a (10a) Shrub understory and intershrub spaces understory grassy, dominated by *Piptochaetium fimbriatum* and/or *Festuca arizonica*:..... ***Quercus gambelii* / *Piptochaetium fimbriatum* - *Festuca arizonica* Woodland**

11b *Piptochaetium fimbriatum* or *Festuca arizonica* poorly represented or absent:..... **12**

12a (11b) *Robinia neomexicana* codominant well represented to luxuriant:..... ***Quercus gambelii* / *Robinia neomexicana* Shrubland**

12b *Robinia neomexicana* incidental or absent in shrub understory and intershrub spaces sparse with scattered forbs and graminoids such as *Carex inops*: ..... ***Quercus gambelii* / *Carex inops* Shrubland**

13a (10b) *Robinia neomexicana* dominant and luxuriant; shrub understory and intershrub spaces may be grassy and dominated by *Piptochaetium fimbriatum*, *Festuca arizonica*, and other montane grasses or they may be sparse: ..... ***Robinia neomexicana* / *Piptochaetium fimbriatum* Shrubland**

13b *Robinia neomexicana* absent: ..... **unclassified shrubland**

Subkey 2B: Desert Shrublands

1a *Larrea tridentata* is the dominant or codominant shrub: **2**

1b *Larrea tridentata* is not the dominant or codominant shrub: **10**

2a (1a) Shrub understories and intershrub spaces grassy: **3**

2b Shrub understories and intershrub spaces sparse or dominated by subshrubs, succulents: **7**

3a (2a) *Bouteloua eriopoda* well represented and dominant: . . . . . .***Larrea tridentata / Bouteloua eriopoda* Shrubland**

3b *Bouteloua eriopoda* uncommon or absent: **4**

4a (3b) *Bouteloua gracilis* well represented and dominant:. . . . ***Larrea tridentata / Bouteloua gracilis* Shrubland**

4b *Bouteloua gracilis* uncommon or absent:. **5**

5a (4b) *Muhlenbergia porteri* and *Setaria leucopila* well represented and dominant:. . . . . .***Larrea tridentata / Muhlenbergia porteri* Shrubland**

5b *Muhlenbergia porteri* and *Setaria leucopila* uncommon, clearly incidental, or absent: **6**

6a (5b) Understory and intershrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: . . . . . .***Larrea tridentata / Sporobolus airoides* Shrubland**

6b *Sporobolus airoides* poorly represented or absent: . . . . . ***Larrea tridentata / Sporobolus flexuosus* Shrubland**

7a (2b) *Krameria grayi* well represented and usually the dominant subshrub:. . . . . .***Larrea tridentata - Krameria grayi* Shrubland**

7b *Krameria grayi* uncommon, clearly incidental, or absent: **8**

8a (7b) *Parthenium incanum* dominates the intershrub spaces along with a variety of other subshrubs and succulents: . . . . . ***Larrea tridentata - Partheniumincanum* Shrubland**

8b Subshrubs and succulents scattered and sparse in the intershrub spaces: **9**

9a (8b) *Flourensia cernua* codominant shrub: . . . . . ***Larrea tridentata - Flourensia cernua* Sparse Shrubland**

9b *Flourensia cernua* uncommon, clearly incidental, or absent: . . . . . .***Larrea tridentata* / Sparse Understory Shrubland**

10a (1b) F*lourensia cernua* the dominant shrub. Graminoid cover is well represented to luxuriant and dominated by *Muhlenbergia porteri* and/or *Setaria leucopila*: . . . . . ***Flourensia cernua / Muhlenbergia porteri* Shrubland**

10b *Flourensia cernua* poorly represented or absent: **11**

11a (10b) *Psorothamnus scoparius* common, the dominant or codominant shrub: . . . . . ***Psorothamnus scoparius* / *Sporobolus flexuosus* Shrubland**

11b *Psorothamnus scoparius* uncommon or absent, clearly incidental: **12**

12a (11b) *Poliomintha incana* common as the dominant or codominant shrub: **13**

12b *Poliomintha incana* uncommon or absent: **15**

13a (12a) Graminoid cover typically well represented and dominated by *Bouteloua breviseta*; gypsophilous soils: . . . . . ***Poliomintha incana* / *Bouteloua breviseta* Gypsophilous Shrubland**

13b *Bouteloua breviseta* uncommon or absent: **14**

14a (13b) Graminoid cover dominated by *Andropogon hallii*; dunelands: . . . . . ***Poliomintha incana* / *Andropogon hallii* Shrubland**

14b *Andropogon hallii* absent or incidental; graminoids scattered and dominated by *Sporobolus flexuosus*: . . . . . ***Poliomintha incana* / *Sporobolus flexuosus* Shrubland**

15a (12b) *Acacia neovernicosa* common as the dominant or codominant shrub: **16**

15b *Acacia neovernicosa* uncommon, incidental or absent: **17**

16a (15a) Graminoid cover usually well represented and dominated by *Bouteloua eriopoda*: . . . . . ***Acacia neovernicosa* / *Bouteloua eriopoda* Shrubland**

16b Graminoid cover poorly represented, scattered; sites typically dominated by succulents and subshrubs: . . . . . ***Acacia neovernicosa* - *Agave lechuguilla* Shrubland**

17a (15b) *Mimosa aculeaticarpa* var. *biuncifera* well represented, the dominant shrub; sites often grassy: . . . . . ***Mimosa aculeaticarpa* var. *biuncifera* / *Bouteloua curtipendula* Shrubland**

17b *Mimosa aculeaticarpa* var. *biuncifera* absent or incidental: **8**

18a (17b) *Mortonia scabrella* well represented, the dominant shrub or subshrub: . . . . . ***Mortonia scabrella* - *Parthenium incanum* Shrubland**

18b *Mortonia scabrella* absent or incidental: **19**

19a (18b) *Viguiera stenoloba* well represented, the dominant shrub: . . . . . ***Viguiera stenoloba* / *Parthenium incanum* Shrubland**

19b *Viguiera stenoloba* absent or incidental: **20**

20a (19b) *Fouquieria splendens* at least common, conspicuous dominant or codominant shrub: **21**

20b *Fouquieria splendens* absent or incidental: **22**

21a (20a) *Tiquilia greggii* common to well represented, usually the dominant subshrub: . . . . . ***Fouquieria splendens* / *Tiquilia greggii* Shrubland**

21b *Tiquilia greggii* absent or incidental, *Parthenium incanum* usually well represented to abundant: . . . . . ***Fouquieria splendens* / *Parthenium incanum* Shrubland**

22a (20b) *Atriplex canescens* is the dominant shrub: **23**

22b *Atriplex canescens* is not the dominant shrub: **27**

23a (22a) *Sporobolus nealleyi*, *Sartwellia flaveriae* and other gypsophiles common, conspicuous indicators gypsum soils: **24**

23b *Sporobolus nealleyi*, *Sartwellia flaveriae* and other gypsophiles uncommon or absent: **26**

24a (23a) *Sporobolus nealleyi* the dominant grass: . . . . . ***Atriplex canescens* / *Sporobolus nealleyi* Shrubland**

24b *Sporobolus nealleyi* uncommon, or absent. *Sartwellia flaveriae* usually well represented along with other gypsophiles: **25**

25a (24b) *Muhlenbergia porteri* the dominant grass: . . . . . ***Atriplex canescens* / *Muhlenbergia porteri* - *Sartwellia flaveriae* Shrubland**

25b *Muhlenbergia porteri* uncommon or absent; *Sporobolus airoides* the dominant grass: . . . . . ***Atriplex canescens* / *Sporobolus airoides* - *Sartwellia flaveriae* Shrubland**

26a (23b) Understory and intershrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: . . . . . ***Atriplex canescens* / *Sporobolus airoides* Shrubland**

26b *Sporobolus airoides* poorly represented or absent understory and intershrub spaces dominated by *Sporobolus flexuosus*, usually sandy sites: . . . . . ***Atriplex canescens* / *Sporobolus (flexuosus, contractus, cryptandrus)* Shrubland**

27a (22b) *Prosopis glandulosa* clearly dominant: **28**

27b *Prosopis glandulosa* usually poorly represented, incidental, or absent: **30**

28a (27a) Understory and intershrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: . . . . . ***Prosopis glandulosa* / *Sporobolus airoides* Shrubland**

28b *Sporobolus airoides* poorly represented or absent: **29**

29a (28b) Understory and intershrub spaces dominated by *Sporobolus flexuosus*, usually sandy sites: . . . . . ***Prosopis glandulosa* / *Sporobolus flexuosus* Ruderal Shrubland**

29b *Sporobolus flexuosus* poorly represented or absent; ephemeral desert wash sites with scattered shrubs: . . . . . ***Prosopis glandulosa* Dry Wash Shrubland**

30a (27b) *Juglans microcarpa* well represented and codominant: ..... ***Juglans microcarpa - Fallugia paradoxa / Bouteloua curtipendula*** **Forested Wetland**

30b *Juglans microcarpa* poorly represented, incidental or absent: **31**

31a (30b) *Ungnadia speciosa* well represented and codominant with *Fallugia paradoxa*: ..... ***Fallugia paradoxa - Ungnadia speciosa*** **Shrubland**

31b *Ungnadia speciosa* poorly represented, incidental or absent: **32**

32a (31b) *Chilopsis linearis* well represented and codominant with *Fallugia paradoxa*: ..... ***Chilopsis linearis - Fallugia paradoxa*** **Shrubland**

32b *Chilopsis linearis* poorly represented, incidental or absent: **33**

33a (32b) *Brickellia laciniata* well represented and codominant with *Fallugia paradoxa*: ..... ***Fallugia paradoxa - Brickellia laciniata*** **Shrubland**

33b *Fallugia paradoxa* dominant. *Brickellia laciniata* poorly represented, incidental or absent: ..... ***Fallugia paradoxa*** **Desert Wash Shrubland**

KEY 3: Herbaceous Vegetation

1a *Festuca arizonica* well represented to abundant, the dominant or codominant grass: ..... ***Festuca arizonica - Bouteloua gracilis*** **Grassland**

1b *Festuca arizonica* poorly represented, incidental, or absent: **2**

2a (1b) *Achnatherum lobatum* well represented to abundant, dominant or codominant: ..... ***Achnatherum lobatum - Bouteloua curtipendula*** **Grassland**

2b *Achnatherum lobatum* poorly represented, incidental, or absent: **3**

3a (2b) *Nassella tenuissima* well represented to abundant, dominant or codominant: ..... ***Nassella tenuissima - Bouteloua gracilis*** **Grassland**

3b *Nassella tenuissima* poorly represented, incidental, or absent: **4**

4a (3b) *Muhlenbergia pauciflora* well represented to abundant, dominant or codominant: ..... ***Viguiera stenoloba / Muhlenbergia pauciflora*** **Shrub Grassland**

4b *Muhlenbergia pauciflora* poorly represented, incidental, or absent: **5**

5a (4b) *Muhlenbergia emersleyi* well represented to abundant, dominant, or codominant: **6**

5b *Muhlenbergia emersleyi* poorly represented, incidental, or absent: **7**

6a (5a) *Nolina microcarpa* or *Nolina texana* usually well represented, the dominant shrub: ..... ***Nolina (texana, microcarpa) / Muhlenbergia emersleyi*** **Shrub Grassland**

6b *Dasylirion leiophyllum* usually well represented, the dominant shrub: . . . . . ***Dasylirion leiophyllum* / *Muhlenbergia emersleyi* Shrub Grassland**

7a (5b) *Muhlenbergia setifolia* well represented to abundant, dominant or codominant: **8**

7b *Muhlenbergia setifolia* poorly represented, incidental, or absent: **11**

8a (7a) *Bouteloua eriopoda* well represented to abundant, codominant: . . . . . ***Muhlenbergia setifolia - Bouteloua eriopoda* Grassland**

8b *Bouteloua eriopoda* poorly represented, incidental, or absent: **9**

9a (8b) *Nolina microcarpa* or *Nolina texana* usually well represented, the dominant shrub: . . . . . ***Nolina (texana, microcarpa)* / *Muhlenbergia setifolia* Shrub Grassland**

9b *Nolina microcarpa* and *Nolina texana* poorly represented, not dominant or codominant among shrubs: . **10**

10a (9b) *Agave lechuguilla* common: . . . . . ***Dasylirion leiophyllum - Agave lechuguilla* / *Muhlenbergia setifolia* Shrub Grassland**

10b *Agave lechuguilla* uncommon, incidental, or absent: . . . . . ***Dasylirion leiophyllum* / *Muhlenbergia setifolia* Shrub Grassland**

11a (7b) *Hesperostipa neomexicana* well represented to abundant, dominant or codominant: **12**

11b *Hesperostipa neomexicana* poorly represented, incidental, or absent: **13**

12a (11a) *Dasylirion wheeleri* usually well represented, the dominant shrub: . . . . . ***Hesperostipa neomexicana* / *Dasylirion wheeleri* Grassland**

12b *Dasylirion wheeleri* poorly represented, incidental, or absent . . . . . ***Hesperostipa neomexicana - Bouteloua curtipendula* Grassland**

13a (11b) *Bouteloua eriopoda* well represented to abundant, dominant or codominant: **14**

13b *Bouteloua eriopoda* poorly represented, incidental, or absent: **25**

14a (13a) *Nolina microcarpa* or *Nolina texana* common to abundant: . . . . . ***Nolina (texana, microcarpa)* / *Bouteloua eriopoda* Shrub Grassland**

14b *Nolina microcarpa* and *Nolina texana* poorly represented or absent: **15**

15a (14b) *Yucca elata* common to well represented, the dominant shrub: **16**

15b *Yucca elata* uncommon, not dominant or codominant among shrubs: **17**

16a (15a) *Bouteloua gracilis* a codominant grass: . . . . . ***Yucca elata* / *Bouteloua eriopoda - Bouteloua gracilis* Shrub Grassland**

16b *Bouteloua gracilis* uncommon, incidental, clearly not codominant:. . . . . ***Yucca elata* / *Bouteloua eriopoda* Shrub Grassland**

17a (15b) *Yucca torreyi* common to well represented, the dominant shrub:. . . . . ***Yucca torreyi* / *Bouteloua eriopoda* Shrub Grassland**

17b *Yucca torreyi* uncommon, not dominant or codominant among shrubs: **18**

18a (17b) *Fouquieria splendens* well represented to abundant, the conspicuous dominant shrub:. . . . . ***Fouquieria splendens* / *Bouteloua eriopoda* Shrub Grassland**

18b *Fouquieria splendens* poorly represented, not dominant or codominant among shrubs:. **19**

19a (18b) *Viguiera stenoloba* well represented to abundant, the dominant shrub: . . . . . ***Viguiera stenoloba* / *Bouteloua eriopoda* Shrub Grassland**

19b *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: **20**

20a (19b) *Agave lechuguilla* well represented to abundant, the dominant subshrub:. . . . . ***Agave lechuguilla* / *Bouteloua eriopoda* Dwarf-shrubland**

20b *Agave lechuguilla* poorly represented, not dominant or codominant among subshrubs:. **21**

21a (20b) *Parthenium incanum* well represented to abundant, the codominant subshrub: . . . . . ***Parthenium incanum* / *Bouteloua eriopoda* Shrub Grassland**

21b *Parthenium incanum* poorly represented, shrubs and subshrubs scattered, incidental: **22**

22a (21b) *Hesperostipa neomexicana* well represented to abundant, codominant:. . . . . ***Bouteloua eriopoda* - *Hesperostipa neomexicana* Grassland**

22b *Hesperostipa neomexicana* poorly represented, incidental, or absent:. **23**

23a (22b) *Muhlenbergia porteri* well represented to abundant, codominant:. . . . . ***Bouteloua eriopoda* - *Muhlenbergia porteri* Grassland**

23b *Muhlenbergia porteri* poorly represented, incidental, or absent:. 24

24a (23b) *Bouteloua gracilis* well represented to abundant, dominant or codominant: . . . . . ***Bouteloua eriopoda* - *Bouteloua gracilis* Grassland**

24b *Bouteloua curtipendula* codominant; *Bouteloua gracilis* poorly represented, incidental, or absent:. . . . . ***Bouteloua eriopoda* - *Bouteloua curtipendula* Grassland**

25a (13b) *Bouteloua gracilis* well represented to abundant, dominant or codominant:. **26**

25b *Bouteloua gracilis* poorly represented, incidental, or absent:. **30**

26a (25a) *Viguiera stenoloba* well represented to abundant, the dominant shrub:. . . . . ***Viguiera stenoloba* / *Bouteloua gracilis* Shrub Grassland**

26b *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: **27**

27a (26b) *Panicum obtusum* well represented to abundant, codominant: . . ***Bouteloua gracilis - Panicum obtusum*** **Grassland**

27b *Panicum obtusum* poorly represented, incidental, or absent: **28**

28a (27b) *Bouteloua curtipendula* well represented to abundant, codominant: . . . . . ***Bouteloua gracilis - Bouteloua curtipendula*** **Grassland**

28b *Bouteloua curtipendula* poorly represented, incidental, or absent: **29**

29a (28b) *Yucca elata* well represented to abundant, the dominant subshrub: . . . . . ***Yucca elata / Bouteloua gracilis*** **Shrub Grassland**

29b *Yucca elata* poorly represented, stands dominated by annual and perennial ruderal forbs: . . . . . ***Bouteloua gracilis*** **Ruderal Grassland**

30a (25b) *Bouteloua curtipendula* well represented to abundant, dominant or codominant: **31**

30b *Bouteloua curtipendula* poorly represented, incidental, or absent: **33**

31a (30a) *Fouquieria splendens* well represented to abundant, the conspicuous dominant shrub: . . . . . ***Fouquieria splendens / Bouteloua curtipendula*** **Shrub Grassland**

31b *Fouquieria splendens* poorly represented, not dominant or codominant among shrubs: **32**

32a (31b) *Viguiera stenoloba* well represented to abundant, the dominant shrub: . . . . . ***Viguiera stenoloba / Bouteloua curtipendula*** **Shrub Grassland**

32b *Dasylirion leiophyllum* usually well represented, the dominant shrub; *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: . . . . . ***Dasylirion leiophyllum / Bouteloua curtipendula*** **Shrub Grassland**

33a (30b) *Krameria grayi* well represented to abundant, the codominant subshrub: . . . . . ***Krameria grayi / Dasyochloa pulchella*** **Dwarf-shrub Grassland**

33b *Krameria grayi* poorly represented, shrubs and subshrubs scattered, incidental: **34**

34a (33b) *Tiquilia hispidissima, Bouteloua breviseta, Sporobolus nealleyi* and other gypsophiles common, conspicuous indicators gypsum soils: **35**

34b *Tiquilia hispidissima, Bouteloua breviseta, Sporobolus nealleyi* and other gypsophiles uncommon or absent: . **40**

35a (34a) *Tiquilia hispidissima* well represented to abundant, the codominant subshrub: **36**

35b *Tiquilia hispidissima* poorly represented, shrubs and subshrubs scattered, incidental: **39**

36a (35a) *Bouteloua breviseta* well represented to abundant, dominant or codominant: . . . . . ***Tiquilia hispidissima* / *Bouteloua breviseta* - *Sporobolus nealleyi* Shrub Grassland**

36b *Bouteloua breviseta* poorly represented, incidental, or absent: **37**

37a (36b) *Sporobolus nealleyi* well represented to abundant, dominant or codominant: . . . . . ***Tiquilia hispidissima* / *Sporobolus nealleyi* Dwarf-shrubland**

37b *Sporobolus nealleyi* poorly represented, incidental, or absent:. **38**

38a (37b) *Dasyochloa pulchella* well represented to abundant, dominant or codominant:. . . . . ***Tiquilia hispidissima* / *Dasyochloa pulchella* Dwarf-shrub Grassland**

38b *Dasyochloa pulchella* poorly represented, incidental, or absent: . . . . . ***Tiquilia hispidissima* / *Sartwellia flaveriae* Dwarf-shrubland**

39a (35b) *Bouteloua breviseta* well represented to abundant, dominant or codominant: . . . . . ***Ephedra torreyana* / *Bouteloua breviseta* Dwarf-shrub Grassland**

39b *Sporobolus nealleyi* well represented to abundant; codominant with *Sporobolus airoides*; *Bouteloua breviseta* poorly represented, incidental, or absent . . . . . ***Sporobolus nealleyi* - *Sporobolus airoides* Grassland**

40a (34b) *Sporobolus airoides* well represented to abundant, dominant in near monotypic stands:. . . . . ***Sporobolus airoides* Monotype Wet Meadow**

40b *Sporobolus airoides* poorly represented, incidental, or absent 41

41a (40b) Stands dominated by *Setaria leucopila* and other ruderal grasses and forbs: . . . . . ***Setaria leucopila* / *Solanum elaeagnifolium* Grassland**

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Appendix C. Local Plant Association Descriptions for Guadalupe Mountains NP

As part of the Guadalupe Mountains NP vegetation classification and mapping project, local plant association descriptions were written for 129 plant associations among 29 USNVC groups identified for the park during the classification and mapping phase of the project (plant associations detected during the accuracy assessment phase are included). Local descriptions provide information on the park-level distribution, level of acceptable physiognomic and compositional variation, and the key ecological process and environmental/abiotic factors that are associated with a type (Grossman et al. 1998).

At this time, the Guadalupe Mountains NP descriptions have not been integrated into the national database maintained by NatureServe, but where a given association is recognized in the National Vegetation Classification, the NatureServe database code (codes beginning "CEGL") has been provided that can be used to query NatureServe's Explorer website for additional information at a global level (http://www.natureserve.org/explorer). In this appendix, the arrangement of the plant associations follows a new hierarchy per FGDC (2008) and Tables 4A–4L of the main report.

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G201. Madrean Encinal Group

***Quercus grisea - Arbutus xalapensis* Woodland**
Gray Oak - Texas Madrone Woodland (Table C1)

Identifier: CEPP007103

Table C1. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Encinal Group [G201]
Association	*Quercus grisea - Arbutus xalapensis* Woodland

Distribution
This uncommon association is present in the Eastern Escarpment (south of Rader Ridge), and McKittrick Canyon areas of Guadalupe Mountains NP.

Environmental Description
This association is found in drainages within the elevation range of 5,590 to 5,702 ft (1,703 and 1,738 m). Drainages vary in aspect, and range in gradient from gentle to steep. Sites are rocky with patches of litter interspersed among the grasses. Geologic substrates are older alluvial deposits and the Capitan Limestone.

Soils are classified as Pinery, Choza, or Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), and Victorio-Lozen Rock outcrop complex, 40 to 95% slopes (VLH) (loamy-skeletal or clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This woodland association is dominated by *Arbutus xalapensis* and *Quercus grisea* in the tree canopy (Table C2), and *Ungnadia speciosa* and *Dasylirion leiophyllum* in the shrub canopy. The combination of trees and shrubs create a closed canopy under which the herbaceous layer varies but does not exceed 20% cover. This layer may include *Bouteloua curtipendula* or *Leptochloa dubia* in excess of 5% cover and is likely to include *Muhlenbergia emersleyi* in smaller amounts. Where forbs occur, *Erigeron flagellaris* can be well represented, while the other 32 recorded species are generally scarce.

Table C2. Most Abundant Species

Stratum	Species
Tree canopy	*Quercus grisea, Arbutus xalapensis*

Other Noteworthy Species
Verbascum thapsus, an introduced biennial forb species, is an infrequent associate.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC013, 08SS018, 10TN005.
Local Description Authors: H. Varani

***Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland**
Gray Oak - Alligator Juniper / Bullgrass (Grama Grass) Woodland (Table C3)

Identifier: CEPP007106

Table C3. Table US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Encinal Group [G201]
Association	*Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi (Bouteloua* spp.*)* Woodland

Distribution
This common association is most often observed in the Pine Springs Canyon area of Guadalupe Mountains NP, but also occurs in the McKittrick Canyon area.

Environmental Description
This association is found within the elevation range of 5,310 to 5,997 ft (1,618 to1,827 m) on gentle limestone slopes with varying aspects. Sites are not particularly rocky, and may feature some gravel and some litter patches among the generally luxuriant herbaceous vegetation. Most sites are situated on older alluvial deposits, but other geologic substrates include the Cherry Canyon Formation and Capitan Limestone.

Soils are mapped in the following four units. McKittrick-Riverwash complex, 0 to 3% slopes (MCB) are loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls, known to flood periodically. Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG) are very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic. Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls. Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) are loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents (USDA NRCS and USDI NPS 2010).

Vegetation Description
The usually open canopy of this woodland association is dominated by *Quercus grisea* and *Juniperus deppeana* (Table C4). The luxuriant grassy understory is dominated by *Muhlenbergia emersleyi*. Often *Bouteloua gracilis* is codominant, and frequently *Bouteloua hirsuta* and *Bouteloua curtipendula* are abundant. Other associated grass species often include *Eragrostis intermedia*, *Bothriochloa barbinodis* and *Lycurus setosus*. The shrub canopy ranges from open to sparse and is composed of several species including regeneration of the aforementioned tree species. The most frequent of the 34 recorded shrub and subshrub species are *Opuntia engelmannii*, *Dasylirion leiophyllum*, *Mimosa aculeaticarpa* var. *biuncifera*, *Nolina texana*, *Rhus trilobata*, and the cacti *Opuntia phaeacantha*. A variety of 57 forbs are recorded, averaging 5% of the total cover; most often included are *Tragia ramosa*, *Viguiera dentata*, *Erigeron flagellaris*, and *Chamaesyce chaetocalyx*.

Table C4. Most Abundant Species

Stratum	Species
Tree canopy	*Quercus grisea, Juniperus deppeana,*
Herb	*Muhlenbergia emersleyi, Bouteloua hirsuta, Bouteloua gracilis, Bouteloua curtipendula*

Other Noteworthy Species
Euphorbia davidii (an annual species) and *Marrubium vulgar*e (a perennial species) are both introduced forb species and infrequent associates.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC193, 07YC035, 07YC036, 07YC037, 08GM005.
Local Description Authors: H. Varani

***Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora* Woodland**
Gray Oak - Alligator Juniper / New Mexico Muhly Woodland (Table C5)

Identifier: CEPP007144

Table C5. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Encinal Group [G201]
Association	*Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora* Woodland

Distribution
This association occurs in the McKittrick Canyon, Eastern Escarpment (south of Smith Canyon, north of Guadalupe Spring), and Pine Spring Canyon areas of Guadalupe Mountains NP.

Environmental Description
This association occurs on moderate slopes near and in drainages between 5,350 and 6,455 ft (1,630 and 1,836 m) with a variety of aspects. Sites are rocky and/or gravelly, but the ground surface can have a significant component of grass cover and litter. Geologic substrates are primarily limestones from the Cherry Canyon Formation, the Bell Canyon Formation (Hegler limestone member) and occasionally the Capitan Limestone, as well as alluvial deposits.

Soils are classified primarily as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG). These are very rocky, loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic. Other soils units include Victorio-Lozen Rock outcrop complex, 40 to 95% slopes (VLH) (loamy-skeletal and clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls of forestlands) and McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
The open to moderate tree canopy of this woodland association is dominated by *Quercus grisea*, and codominated by *Juniperus deppeana* (Table C6). *Pinus edulis* may occasionally occur but is incidental. The understory is grass dominated principally by *Muhlenbergia pauciflora*, and frequently codominated by *Muhlenbergia emersleyi*. Grass cover can be luxuriant and diverse; an additional 24 gramoinoid species have been recorded for the association and include *Achnatherum lobatum*, *Schizachyrium scoparium*, *Bouteloua curtipendula*, *Muhlenbergia dubia* and *Lycurus setosus*. Shrubs can be common but seldom exceed 25% cover. Among the 45 shrubs and subshrubs species reported, the most frequent and abundant are montane chaparral elements such as *Viguiera stenoloba*, *Rhus trilobata*, *Quercus* ×

pauciloba, *Cercocarpus montanus* var. *paucidentatus*, and *Gymnosperma glutinosum*, along with common foothill grassland elements such as *Dasylirion leiophyllum*, *Nolina texana*, and *Opuntia phaeacantha* (Table C6). Forbs can be important components of this association with cover averaging greater than 5%. *Erigeron flagellaris* is the most frequent and abundant, though *Rhynchosia senna* var. *texana*, *Galium microphyllum*, and *Tragia ramosa* are also commonly present.

Table C6. Most Abundant Species

Stratum	Species
Tree canopy	*Quercus grisea, Juniperus deppeana*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC017, 07YC020, 07YC031, 08CJ027, 08GM001, 08GM003, 08GM008, 08SS024, 08SS026.
Local Description Authors: H. Varani and E.H. Muldavin

Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum Woodland
Gray Oak - Alligator Juniper / Pinyon Ricegrass Woodland (Table C7)

Identifier: CEPP007146

Table C7. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Encinal Group [G201]
Association	*Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum* Woodland

Distribution
This infrequent association is known to occur near the mouth of McKittrick Canyon in Guadalupe Mountains NP.

Environmental Description
This site occurs at an elevation of 5,124 ft (1,563 m), on a gentle, lower slope with a northeast aspect. Litter is interspersed with the herbaceous vegetation, and the site has little exposed rock, gravel or soil. The geologic substrate is the Capitan Limestone.

The soil for this site is classified as McKittrick-Riverwash complex, 0 to 3% slopes (MCB), which are loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls. Soils such as these are known to flood periodically (USDA NRCS and USDI NPS 2010).

Vegetation Description
The open tree canopy at this site is dominated by *Juniperus deppeana*, while the fuller subcanopy is dominated by *Quercus grisea* (Table C8). Though the shrub canopy includes ten species, only the dominant *Quercus* × *pauciloba* exceeds 5% cover (*Dasylirion leiophyllum*, *Mimosa aculeaticarpa* var. *biuncifera*, *Nolina texana*, *Opuntia engelmannii*, and

Rhus virens all exceed 1% cover). The grassy understory is full, covering 50%, and is dominated by *Piptochaetium fimbriatum*, while including eight other grass species which don't exceed 5% (*Bouteloua curtipendula*, *Eragrostis intermedia*, and *Muhlenbergia emersleyi* exceed 1%). Twelve forb species are present at this site covering a total of 2%; these include *Chamaesyce chaetocalyx*, *Erigeron flagellaris*, and *Rhynchosia senna* var. *texana*.

Table C8. Most Abundant Species

Stratum	Species
Tree canopy	*Juniperus deppeana, Quercus grisea*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM019.
Local Description Authors: H. Varani

G487. Madrean Juniper Open Woodland Group

***Juniperus deppeana / Bouteloua gracilis* Woodland**
Alligator Juniper / Blue Grama Woodland (Table C9)

Identifier: CEGL000693

Table C9. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Juniper Open Woodland Group [G487]
Association	*Juniperus deppeana / Bouteloua gracilis* Woodland

Distribution
This infrequent association occurs in West Dog and Pine Spring Canyons in Guadalupe Mountains NP.

Environmental Description
This association can be found on gentle colluvial slopes at the elevations of 5,758 and 6,283 ft (1,756 & 1,916 m). Sites occur in drainages and near arroyos, and both are without rock, but are substantially bare featuring exposed soil or gravel, and variable litter cover. Geologic substrates are limestones of the Carlsbad Limestone and older alluvial deposits.

Soil units are mapped as Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG)(very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), and Lazarus loam, 2 to 9% slopes (LAD)(fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
Both of the observed sites of this woodland association feature open tree canopies of *Juniperus deppeana* (Table C10). At one site, *Quercus grisea* is also well represented. Sites feature a very abundant or luxurious grassy understory dominated by *Bouteloua gracilis*. Other grasses, such as *Hesperostipa neomexicana*, *Lycurus setosus*, and *Piptochaetium fimbriatum*, may occur. Shrub cover averages 15% and 20%, with both plots featuring *Rhus trilobata* and the subshrub *Gutierrezia sarothrae* as poorly represented components. Other shrubs such as *Nolina texana* and *Cercocarpus montanus* are found in one site or the other, but not both. A total of eight forbs cover an average of 2% at each site, however, there are no common forbs between sites.

Table C10. Most Abundant Species

Stratum	Species
Tree canopy	*Juniperus deppeana*
Herb	*Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ019, 10TN001.
Local Description Authors: H. Varani

***Juniperus deppeana / Muhlenbergia pauciflora* Woodland**
Alligator Juniper / New Mexico Muhly Woodland (Table C11)

Identifier: CEPP006891

Table C11. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Juniper Open Woodland Group [G487]
Association	*Juniperus deppeana / Muhlenbergia pauciflora* Woodland

Distribution
This uncommon association is known from the Pine Spring Canyon area and Eastern Escarpment area nearby, to the north, and can be found in the Mountain High country of Guadalupe Mountains NP.

Environmental Description
This association is found within the elevations of 6,276 and 8,249 ft (1,912 and 2,514 m) on moderate to steep colluvial slopes of variable aspect. Sites are rocky with patches of litter and grass. Geologic substrates include the Bell Canyon Formation (with Hegler limestone member) and Carlsbad Limestone.

Soils are classified in the three following units; Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series), Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very

rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This woodland association features open tree canopies composed primarily of *Juniperus deppeana* (Table C12). The grassy understories vary from 30 to 80% cover, and are most likely to be dominated by *Muhlenbergia pauciflora*, with *Muhlenbergia dubia* present to codominant. *Piptochaetium fimbriatum* and *Achnatherum lobatum* may also be abundant in areas where they occur. Shrubs and subshrubs are not a heavy component of this association, and may be absent. When present, they cover less than 5%, and may include *Dasylirion leiophyllum*, *Quercus* × *pauciloba* and *Agave parryi* ssp. *neomexicana*. Similarly scattered are the dozen recorded forbs; the most likely are *Artemisia ludoviciana* and *Viguiera dentata*.

Table C12. Most Abundant Species

Stratum	Species
Tree canopy	*Juniperus deppeana*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species

Polygala rimulicola var. *rimulicola* is a rare plant recognized by New Mexico. In this association it is infrequent. Generally found in crevices of limestone cliffs of montane scrub to lower montane coniferous forests, this species is only found in Eddy County, New Mexico, and in adjacent (Hudspeth and Gulberson counties) Texas in the Sierra Diablo and Guadalupe Mountains.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM080, 06EM106, 06YC192, 08CJ095.
Local Description Authors: H. Varani

***Juniperus deppeana / Quercus* × *pauciloba / Bouteloua curtipendula* Woodland**
Alligator Juniper / Wavyleaf Oak / Sideoats Grama Woodland (Table C13)

Identifier: CEPP006892

Table C13. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Juniper Open Woodland Group [G487]
Association	*Juniperus deppeana / Quercus* × *pauciloba / Bouteloua curtipendula* Woodland

Distribution

This very common association exists predominantly in the Mountain High County area, as well as being scattered through the McKittrick Canyon, Eastern escarpment, and Pine Spring Canyon areas of Guadalupe Mountains NP.

Environmental Description

In this association, elevation ranges from 5,154 to 7,800 ft (1,570 and 2,378 m). It occurs across moderate to steep slopes of mostly northerly aspects at lower elevations and southerly at the higher elevations. Sites are rocky and gravelly, but the ground surface can have a significant component of grass cover and litter. Generally, geological substrates are the Carlsbad and Capitan Limestones (and rarely on the breccia member of the Capitan Limestone). In Pine Spring Canyon, it occurs on older alluvial deposits. In Smith Canyon, it occurs on the Pinery limestone member of the Bell Canyon Formation.

Soils are classified primarily as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH), and are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls. The sites in Smith and Pine Spring Canyon soil units are classified as Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic. A final minor soil unit is the McKittrick-Riverwash complex, 0 to 3% slopes (MCB), composed of loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description

This woodland association is characterized by an open tree canopy dominated by *Juniperus deppeana* with a high cover of shrubs dominated by *Quercus x pauciloba* under the trees and in the inter-tree spaces (Table C14). Other common shrubs and subshrubs include *Rhus trilobata*, *Cercocarpus montanus*, *Dasylirion leiophyllum*, *Nolina texana*, *Yucca baccata*, and *Agave parryi* ssp. *neomexicana*. Grasses can also be abundant and are most frequently dominated by *Bouteloua curtipendula* along with *Muhlenbergia pauciflora*, *Muhlenbergia dubia*, and *Muhlenbergia emersleyi*. Forb species are diverse (43 species have been recorded) but variable across stands; the most frequent are *Tragia ramosa*, *Erigeron flagellaris*, and *Brickellia brachyphylla*. *Pinus edulis* can occur, but is clearly subordinate to *Juniperus deppeana* in the canopy.

Table C14. Most Abundant Species

Stratum	Species
Tree canopy	*Juniperus deppeana*
Shrub canopy	*Quercus* × *pauciloba*
Herb	*Bouteloua curtipendula, Muhlenbergia pauciflora*

Other Noteworthy Species

Solidago wrightii var. *guadalupensis*, a New Mexico rare plant, is scarce in this association. It is generally found on limestone outcrops and substrates in Chaves and Eddy counties, New Mexico, and in Culberson County, Texas.

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections. It is scattered in this association.

Elaeagnus angustifolia is a class C noxious weed on the NM state list. It was found once in this association, as seedlings.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC185, 06YC186, 06YC188, 06YC199, 07CJ025, 10CJ007, 10CJ038, 10CJ042, 10CJ052, 10EL034, 10EL051.
Local Description Authors: H. Varani and E.H. Muldavin

G200. Madrean Pinyon - Juniper Woodland Group

***Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum* Woodland**
Two-needle Pinyon - Alligator Juniper / Pinyon Ricegrass Woodland (Table C15)

Identifier: CEPP006947

Table C15. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Pinyon - Juniper Woodland Group [G200]
Association	*Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum* Woodland

Distribution
This infrequent association occurs in the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
This association is found within the elevations of 7,251 and 7,520 ft (2,210 and 2,292 m), on moderate colluvial slopes, of variable aspects. Sites feature grass and litter patches in the tree and shrub interspaces, and may occasionally be rocky. The geologic substrate is the Carlsbad Limestone.

Soils are mapped primarily as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series. One site is located on soils mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) which are rangeland soils made up of loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This woodland association is characterized by tree canopies with 40% to 60% cover that are dominated by *Juniperus deppeana* and *Pinus edulis* (Table C16). Grass in the understory is typically very abundant, but may be as little as 10% where woody canopies are very dense. *Piptochaetium fimbriatum* is typically the dominant, though occasionally *Piptatherum micranthum* may dominate. Often *Muhlenbergia dubia*, *Muhlenbergia pauciflora*, *Muhlenbergia emersleyi* and *Eragrostis intermedia* also contribute to grass cover. Shrub cover ranges from 5% to 60% cover, with the dominant, *Quercus* × *pauciloba*, ranging from less than 1% to 60% cover. Of the seven other encountered shrubs and subshrubs, none exceeds 5% maximum cover, and include *Nolina texana* and/or *Agave parryi* ssp. *neomexicana*. Eight forbs are recorded; these are variable and scattered with a total average cover of 1%.

Table C16. Most Abundant Species

Stratum	Species
Tree canopy	*Juniperus deppeana, Pinus edulis*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM081, 06YC220, 10CJ056, 10EL055.
Local Description Authors: H. Varani

***Pinus edulis / Muhlenbergia pauciflora* Woodland**
Two-needle Pinyon / New Mexico Muhly Woodland (Table C17)

Identifier: CEGL000785

Table C17. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Pinyon - Juniper Woodland Group [G200]
Association	*Pinus edulis / Muhlenbergia pauciflora* Woodland

Distribution
This common association is known from the Mountain High Country, Guadalupe Peak, and the Basin and Range (West Dog Canyon) areas of the Guadalupe Mountains NP.

Environmental Description
Found at relatively high elevations, 6,227 to 8,526 ft (1,897 to 2,599 m), this association occurs on moderate to steep northeasterly colluvial slopes, and gentle ridge-tops. Sites are typically rocky and gravelly (as much as 50% of the ground surface) with patches of litter and grass canopies covering the ground. Geologic substrates include the Carlsbad and Capitan Limestones.

Soils are mapped predominantly as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH), and are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls. One site is atypically mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG), a loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustoll or loamy-skeletal, mixed, superactive, mesic Lithic Calciustoll (USDA NRCS and USDI NPS 2010).

Vegetation Description
This association is characterized by an open to moderately-closed tree canopy dominated by *Pinus edulis* with *Juniperus deppeana* often present but not codominant (Table C18). *Pinus ponderosa* is accidental or absent. *Ostrya knowltonii* was abundant on one site. The inter-tree spaces and understories typically have abundant grass dominated by *Muhlenbergia pauciflora* with small amounts of upland deer sedges (*Carex* spp.) along with a dozen other graminoid species. Shrubs and subshrubs are scatted and not particularly conspicuous but may include *Cercocarpus montanus*, *Ceanothus greggii*, *Yucca baccata*, *Nolina texana*, and *Fendlera rupicola* among the 20 species reported. Forbs are moderately diverse (28 species) but scattered and variable across stands; the most frequently encountered are *Thelesperma longipes*, *Allium kunthii*, *Lithospermum multiflorum*, and P*hemeranthus brevicaulis*.

Table C18. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus edulis*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections. In this association it occurs infrequently.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC212, 07PA019, 08CJ033, 08CJ039, 08CJ042, 08CJ043.
Local Description Authors: H. Varani and E.H. Muldavin

***Pinus edulis / Muhlenbergia setifolia* Woodland**
Two-needle Pinyon / Curlyleaf Muhly Woodland (Table C19)

Identifier: CEPP006971

Table C19. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Pinyon - Juniper Woodland Group [G200]
Association	*Pinus edulis / Muhlenbergia setifolia* Woodland

Distribution
This infrequent association is known to occur in the Brokeoff Mountains, in the Basin and Range area of Guadalupe Mountains NP.

Environmental Description
This association is known to occur at elevations between 6,388 and 6,526 ft (1,947 and 1,989 m) on gentle and moderate, colluvial slopes with northerly aspects. Sites are rocky or bare, with litter concealing an average of nearly 30% of the groundcover. Geologic substrates are the Goat Seep and the Carlsbad Limestones, with one site on the sandstone member of the Carlsbad Limestone.

Soils are mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls), and Lazarus loam, 2 to 9% slopes (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
In this woodland association, *Pinus edulis* dominates the open tree canopies (Table C20) and *Juniperus monosperma* is frequently well represented. The understory is dominated by abundant grass cover, most frequently dominated by *Muhlenbergia setifolia*, though commonly, either *Eragrostis intermedia* or *Bouteloua gracilis* potentially codominate. All sites include some *Bouteloua curtipendula*, and the majority also included *Achnatherum lobatum*, and *Aristida purpurea* var. *nealleyi*. Shrubs are also abundant in this association, and include *Yucca baccata*, *Opuntia engelmannii*, and *Nolina texana*. Subshrubs are poorly represented, and inconsistent from site to site (represented by *Gutierrezia sarothrae*, and/or *Agave parryi* ssp. *neomexicana*). Forbs are variable in this association but don't exceed 10% total cover; of the 19 generally scattered species recorded, *Viguiera dentata*, *Linum vernale*, *Polygala alba*, and *Schoenocrambe linearifolia*, are found at every site.

Table C20. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus edulis*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07PA002, 07PA008.
Local Description Authors: H. Varani

***Pinus edulis / Nassella tenuissima* Woodland**
Two-needle Pinyon / Finestem Needlegrass Woodland (Table C21)

Identifier: CEPP006972

Table C21. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Pinyon - Juniper Woodland Group [G200]
Association	*Pinus edulis / Nassella tenuissima* Woodland

Distribution
This infrequent association is known to occur in the Brokeoff Mountains, in the Basin and Range area of Guadalupe Mountains NP.

Environmental Description
This association is known to occur at elevations between 6,063 and 6,585 ft (1,848 and 2,008 m) on gentle to moderate, colluvial slopes with western aspects. Ground covers at sites approach 20% bare soil and average 30% litter cover, but vary in rock and gravel amounts. Geologic substrates include the Goat Seep and Carlsbad Limestones.

Soils are mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) and Lazarus loam, 2 to 9% slopes (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
Tree canopies of this woodland association vary widely at each site, from 8% cover to 70% cover. *Pinus edulis* is the dominant (Table C22) with *Juniperus monosperma* present to codominant. At one site, *Juniperus deppeana* is also abundant. The grassy understory also varies widely from 20% to 80% cover (of the three observed locations, the site with the sparsest tree canopy also has the steepest gradient, the most rock and gravel cover, and the least herbaceous canopy cover). The dominant grass is *Nassella tenuissima*, sometimes rivaled by *Bouteloua gracilis*. *Achnatherum lobatum* and *Bouteloua curtipendula* are also common among the 12 other grasses observed in this association. Shrubs and subshrubs are variable and poorly represented in this association, with *Mahonia*

haematocarpa as the most frequent associate of the 11 species. Similarly, forbs are poorly represented, and of the 15 scattered forbs *Linum vernale* is common between sites.

Table C22. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus edulis*
Herb	*Nassella tenuissima*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07PA012, 07PA014, 07PA018.
Local Description Authors: H. Varani

***Pinus edulis / Quercus x pauciloba (Cercocarpus montanus var. paucidentatus) / Muhlenbergia pauciflora* Woodland**
Two-needle Pinyon / Wavyleaf Oak (Hairy Mountain Mahogany) / New Mexico Muhly Woodland (Table C23)

Identifier: CEPP006977

Table C23. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Lowland Evergreen Woodland (M010)
Group	Madrean Pinyon - Juniper Woodland Group [G200]
Association	*Pinus edulis* / *Quercus* x *pauciloba (Cercocarpus montanus* var. *paucidentatus)* / *Muhlenbergia pauciflora* Woodland

Distribution
This common association is known from the Guadalupe Peak, High Mountain Country (The Bowl), and the Basin and Range (West Dog Canyon) areas of Guadalupe Mountains NP.

Environmental Description
This association occurs at elevations ranging from 6,722 to 8,508 ft (2,049 to 2,593 m). Stands are found on moderate colluvial slopes (generally around 20%, but as steep as 50%) with southern aspects (occasionally extending to northerly aspects at lower elevations). Sites are typically rocky and with some gravels along with patches of litter and grass covering the ground surface. Geological substrates include limestones and occasionally sandstones of the Carlsbad, Capitan, and Goat Seep Limestones.

Soils were mapped primarily as the Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series. Minor soil units include Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls) and Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This woodland association is characterized by an open to moderately-closed tree canopy dominated by *Pinus edulis* (Table C24) with *Juniperus deppeana* usually present but not codominant. Shrub and grasses are abundant to very abundant in the inter-tree spaces. The dominant shrub is *Quercus* × *pauciloba* with *Cercocarpus montanus* var. *paucidentatus* often a codominant. Among the grasses, *Muhlenbergia pauciflora* is the most common, but several others often occur and include *Eragrostis intermedia*, *Muhlenbergia dubia*, and *Muhlenbergia emersleyi*. *Piptatherum micranthum* is often abundant under tree canopies. Forbs are moderately diverse but scattered and variable across stands (32 species were recorded for the association). The most common species include *Viguiera dentata*, *Allium kunthii*, *Tragia ramosa*, *Eriogonum hieraciifolium*, *Polygala alba*, and *Thelesperma longipes*.

Table C24. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus edulis*
Shrub canopy	*Quercus* × *pauciloba, Cercocarpus montanus* var. *paucidentatus*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM105, 06YC204, 06YC210, 07CJ013, 08CJ034, 08CJ088, 10CJ010, 10CJ026, 10CJ036, 10CJ037, 10CJ053, 10CJ055, 10CJ073, 10EL035, 10EL036, 10EL038, 10EL054, 10EL056, 10EL057.
Local Description Authors: H. Varani and E.H. Muldavin

G203. Madrean Lower Montane Pine - Oak Forest & Woodland Group

***Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii* Forest**
Ponderosa Pine - Bigtooth Maple - Chinkapin Oak Forest (Table C25)

Identifier: CEPP006978

Table C25. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Lower Montane Pine - Oak Forest & Woodland Group [G203]
Association	*Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii* Forest

Distribution
This infrequent association is known to occur in the South McKittrick Canyon and Mountain High Country areas of Guadalupe Mountains NP.

Environmental Description
This association is found at the elevations of 5,308 ft and 7,204 ft (1,618m and 2,196 m) at the bottom of canyons, along streams. Sites are found on gentle alluvial slopes, and are rocky with ground surfaces largely concealed by litter. The geologic substrates are the Bell Canyon Formation (Hegler limestone member), and the Carlsbad Limestone.

Soils are classified as McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls), Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed tree canopy of this forest association is dominated by a combination of *Pinus ponderosa*, *Acer grandidentatum*, and *Quercus muehlenbergii* (Table C26). *Fraxinus velutina* may add substantially to tree cover as well. The shrub canopy exists, but generally does not exceed 10% cover and is primarily composed of regeneration of the aforementioned species. Other shrub species, including *Quercus gambelii*, *Dasylirion leiophyllum*, *Croton fruticulosus*, *Symphoricarpos longiflorus* and *Vitis arizonica* occur at one site or the other, but not both. Similarly, one site had no herbaceous layer at all, while the other has a 30% graminoid cover composed of ten species, and a 7% forb cover composed of 34 species. These included the graminoids: *Piptochaetium fimbriatum*, *Carex microdonta*, and *Cladium californicum* and the forbs: *Packera hartiana* and *Brickellia brachyphylla*.

Table C26. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus ponderosa, Acer grandidentatum, Quercus muehlenbergii*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It occurs in both the canopy and subcanopy of this association, but is not dominant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC184, 10CJ045.
Local Description Authors: H. Varani

***Pinus ponderosa / Muhlenbergia pauciflora* Forest**
Ponderosa Pine / New Mexico Muhly Forest (Table C27)

Identifier: CEPP006980

Table C27. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Lower Montane Pine - Oak Forest & Woodland Group [G203]
Association	*Pinus ponderosa / Muhlenbergia pauciflora* Forest

Distribution
This infrequent association is scattered through the Mountain High Country are, and can be found on Guadalupe Peak of Guadalupe Mountains NP.

Environmental Description
This association is known to occur on colluvial slopes and ridge tops at relatively high elevations between 7,792 and 8,351 ft (2,375 and 2,545 m). Sites vary in steepness, and feature patches litter and rock the vegetated interspaces. Geologic substrates include the Carlsbad and Capitan Limestones.

Soils are mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), and as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This forest association is characterized by open to moderately closed tree canopies dominated by *Pinus ponderosa* (Table C28). The luxuriant grass understory is dominated by the nominal grass *Muhlenbergia pauciflora*. *Muhlenbergia dubia* is common, and occasionally *Panicum bulbosum* and *Muhlenbergia setifolia* can cover more than 15%. Shrub and subshrub cover varies in this association (absent to 10% cover), and most often include the shrubs *Cercocarpus montanus* var. *paucidentatus*, and *Rosa stellata*, and the subshrub *Agave parryi* ssp. *neomexicana*. Forbs are poorly represented, *Allium cernuum* is the most frequent of the 10 recorded species.

Table C28. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus ponderosa*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC211, 08CJ036, 08CJ079, 08CJ082.
Local Description Authors: H. Varani

***Pinus ponderosa / Quercus* × *pauciloba / Muhlenbergia pauciflora* Forest**
Ponderosa Pine / Wavyleaf Oak / New Mexico Muhly Forest (Table C29)

Identifier: CEPP006982

Table C29. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Lower Montane Pine - Oak Forest & Woodland Group [G203]
Association	*Pinus ponderosa / Quercus* × *pauciloba / Muhlenbergia pauciflora* Forest

Distribution
This very common association is scattered through the Mountain High Country area of Guadalupe Mountains NP and on the rims of South McKittrick and West Dog Canyons.

Environmental Description
This association occurs on a variety of upper slopes and ridge-tops with recorded elevations ranging between 6,781 and 8,219 ft (2,067m to 2,505 m). Slopes are colluvial, and tend to be moderately steep, but vary in aspect. Ground surfaces are nearly 40% concealed by litter, and otherwise feature less than 10% bare soil or gravel and rock. Geological substrates include the Capitan and the Carlsbad Limestones.

Soils are mapped primarily as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series. Minor soil units include Lark-Peligro complex outcrop complex, 1 to 8% slopes (LPC) (gypsic, thermic Typic Torripsamments and coarse-gypsums, hypergypsic, thermic Leptic Haplogypsids respectively) and Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
The open tree canopies of this forest association are dominated by *Pinus ponderosa* (Table C30) and frequently include *Juniperus deppeana*, and *Pseudotsuga menziesi*. Shrub cover averages 45% and includes tree regeneration as well as 19 species of shrubs. These are dominated by *Quercus* × *pauciloba*, and frequently include *Fendlera rupicola* and *Rhus trilobata*. Subshrubs are generally absent, occasionally including *Agave parryi* ssp. *neomexicana* or *Gymnosperma glutinosum*. The herbaceous layer is composed primarily of grasses; the 20 recorded species average 45% cover. These are dominated by *Muhlenbergia pauciflora* with *Eragrostis intermedia*, *Muhlenbergia dubia*, *Schizachyrium scoparium*, and *Achnatherum lobatum* frequently occurring, and sometimes well represented. Forbs are a minor component of this association, and are often absent. Of the 26 recorded and variable forb species, only *Artemisia ludoviciana* composes an average of more than 1% cover where it occurs.

Table C30. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus ponderosa*
Shrub	*Quercus* × *pauciloba*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections. It is infrequently scattered in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC209, 07CJ022, 08CJ064, 08CJ065, 08CJ067, 08CJ084, 10CJ009, 10CJ025, 10CJ066, 10CJ072, 10EL025, 10EL031, 10EL053
Local Description Authors: H. Varani

***Pinus ponderosa / Quercus x pauciloba / Piptochaetium fimbriatum* Forest**
Ponderosa Pine / Wavyleaf Oak / Pinyon Ricegrass Forest (Table C31)

Identifier: CEPP006983

Table C31. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Lower Montane Pine - Oak Forest & Woodland Group [G203]
Association	*Pinus ponderosa* / *Quercus* x *pauciloba* / *Piptochaetium fimbriatum* Forest

Distribution
This infrequent association can be found on the north rim of South McKittrick Canyon and in the Mountain High Country are of Guadalupe Mountains NP.

Environmental Description
This association is known to occur within the elevations range of 7,648 to7,749 ft (2,331 to 2,362 m) on gentle to moderate colluvial slopes with variable aspects. Ground surfaces are more than 30% concealed by litter, and may be rocky underneath. Geologic substrates are the Carlsbad Limestone with one site occurring on the sandstone member of this formation.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
Tree canopies range from open to closed in this forest association, and generally the dominant tree is *Pinus ponderosa* except when the association is in the *Pinus strobiformis* phase (then dominated by *Pinus strobiformis*; Table C32). *Juniperus deppeana* is an element and occasionally *Pinus edulis* and/or *Pseudotsuga menziesii* occur. The shrub canopy similarly can range from open to closed, and is dominated by *Quercus* × *pauciloba* and includes *Nolina texana*. The understory is primarily characterized by abundant to very abundant *Piptochaetium fimbriatum* cover, supplemented by the ten other graminoid species that occur, notably including *Muhlenbergia pauciflora*, *Muhlenbergia montana*, and deer sedges (*Carex* spp.). Occasionally *Agave parryi* ssp. *neomexicana* is among the sparse subshrubs found (there are three species recorded). Forbs may be absent or poorly represented and diverse. Of the 19 recorded species recorded, only *Frasera speciosa* occurs at more than one site.

Table C32. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus ponderosa, Pinus strobiformis*
Shrub canopy	*Quercus* × *pauciloba*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM112, 06YC207, 10EL062.
Local Description Authors: H. Varani

***Pinus ponderosa / Quercus gambelii / Piptochaetium fimbriatum* Forest**
Ponderosa Pine / Gambel's Oak / Pinyon Ricegrass Forest (Table C33)

Identifier: CEPP006981

Table C33. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Lower Montane Pine - Oak Forest & Woodland Group [G203]
Association	*Pinus ponderosa / Quercus gambelii / Piptochaetium fimbriatum* Forest

Distribution
This common association is known from the Bowl of the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
This association is known to occur on colluvial slopes within the relatively high elevations of 7,795 and 7,876 ft (2,375 and 2,401 m). Slopes are gentle to moderate with varying aspects; litter conceals the ground surfaces in the vegetated interspaces. Geologic substrates include the Capitan and Carlsbad Limestones, with one site occurring on the sandstone member of Carlsbad Limestone.

Soils are all classified as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This forest association is characterized by open to closed tree canopies dominated by *Pinus ponderosa* (Table C34), with *Pseudotsuga menziesii* also poorly represented at all sites. *Quercus gambelii* dominates the abundant to very abundant shrub layer. However, *Robinia neomexicana* that can cover as much as 40%. *Symphoricarpos* sp. is common. Dwarf-shrubs are generally absent with *Mahonia repens* as the only species. The abundant to very abundant grassy understory is usually dominated by *Piptochaetium fimbriatum* which is the only graminoid species that is consistently present. Occasionally *Piptochaetium pringlei* can approach 10% cover, but the other five recorded graminoid species are poorly represented. Forbs range from absent to as much as 30% cover. The most common of the nine forbs, *Vicia Americana*, is poorly represented; *Artemisia ludoviciana* ssp. *Mexicana*, is occasionally abundant while the remaining forbs are scattered.

Table C34. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus ponderosa, Quercus gambelii*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ015, 10CJ016, 10CJ020, 10EL013, 10EL020
Local Description Authors: H. Varani

G202. Madrean Upper Montane Conifer - Oak Forest & Woodland Group

***Acer grandidentatum - Quercus grisea* Forest**
Bigtooth Maple - Gray Oak Forest (Table C35)

Identifier: CEPP006870

Table C35. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Acer grandidentatum - Quercus grisea* Forest

Distribution
This uncommon association is known to occur in the McKittrick and the Pine Spring Canyon areas of Guadalupe Mountains NP.

Environmental Description
Examples of this association occur in the elevation range of 5,154 to 6,286 ft (1,571 to 1,917 m). Sites are alluvial or colluvial, and may occur on moderate slopes among boulders or have very little slope and smaller surface rock. Geologic substrates are the Capitan Limestone (massive layers and breccia members) and the Bell Canyon Formation (Pinery limestone member).

Soils are mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls) with one site occurring on McKittrick-Riverwash complex soils, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
The open tree canopies of this forest association are dominated by a combination of *Acer grandidentatum* and *Quercus grisea* (Table C36), with *Pinus ponderosa* often present to well represented. Usually, *Juniperus deppeana* is also an element of the canopy with *Arbutus xalapensis*, *Juglans microcarpa*, *Juniperus pinchotii*, *Ostrya knowltonii* less constant. Understories vary; when woody in character, shrubs may contribute as much as 40% cover, consist of 18 recorded species, and likely include *Dasylirion leiophyllum*. Subshrubs are sparse, *Agave parryi* ssp. *neomexicana*, or *Gymnosperma glutinosum* are the most likely. When herbaceous in character, graminoids may be dominated by *Schizachyrium scoparium* or *Melica nitens*, likely include *Andropogon gerardii* and may also include *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, and/or *Muhlenbergia repens*. Forbs are scattered and include 19 recorded species, most appearing at only one of the recorded sites. *Viguiera dentata*, *Acalypha phleoides*, *Erigeron flagellaris* all exceed 1% cover

where they occur.

Table C36. Most Abundant Species

Stratum	Species
Tree canopy	*Acer grandidentatum, Quercus grisea*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is poorly represented in this association, observed at one of the three sites. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ023, 08CJ032, 08GM020.
Local Description Authors: H. Varani

***Acer grandidentatum - Quercus muehlenbergii* Forest**
Bigtooth Maple - Chinkapin Oak Forest (Table C37)

Identifier: CEGL004547

Table C37. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Acer grandidentatum - Quercus muehlenbergii* Forest

Distribution
This very common association is scattered through the Pine Springs Canyon, Eastern Escarpment, and McKittrick Canyon areas of Guadalupe Mountains NP. It occurs infrequently in the Mountain High Country, West Dog Canyon, and Basin and Range areas of the park as well.

Environmental Description
This association occurs within the elevation range of 5,141 to 7,428 ft (1,567 to 2,266 m) in canyons and drainages on valley floors and lower slopes with variable gradients and aspects. Sites are typically rocky and ground surfaces are 40% concealed by litter, on average. Sites occur on the Capitan Limestone (on and off of the breccia member), Goat Seep Limestone and on the Hegler limestone and Pinery limestone members of the Bell Canyon Formation.

Soils are mapped in several units, these described following in the order of preponderance. The McKittrick Riverwash complex, 0 to 3% slopes (MCB) are occasionally to frequently flooded, loamy-skeletal, carbonatic, superactive, mesic Fluvent Haplustolls that occur in limestone valley bottoms. The Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH), are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls. The Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) are very rocky loamy-skeletal, mixed, superactive, thermic Calciustoll (Calciustolls further classified as Lithic, shallow Petrocalci, or Aridic respective to series). The

Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH), are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls. The Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG), form on shallow limestones and are classified as loamy-skeletal, mixed, superactive, mesic soils which may be further classified as either Aridic Lithic Haplustolls or Lithic Calciustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description

This forest association is characterized by a dense tree canopy (60% average cover), dominated by *Acer grandidentatum* and *Quercus muehlenbergii (*Table C38), frequently alongside *Arbutus xalapensis*, and *Juniperus deppeana* (*Pinus ponderosa* is also often present, but trivial in cover). Regeneration of these tree species is evident. Shrub canopies average 16% cover and are composed of a wide variety of shrubs (33 species are recorded, 15 of which appear repeatedly). The most common are *Dasylirion leiophyllum*, *Fendlera rupicola*, *Quercus* × *pauciloba*, and *Rhus trilobata*. The herbaceous layer varies in density (from absent to 40% cover) and is most often dominated by *Muhlenbergia pauciflora*. It may also include noticeable populations of *Piptochaetium fimbriatum* or *Schizachyrium scoparium* and frequently includes *Muhlenbergia emersleyi*. Forbs are sometimes absent, and rarely exceeding 5% total cover; *Brickellia brachyphylla*, *Linum schiedeanum*, and *Galium microphyllum* are the most common of the 69 scattered species.

Table C38. Most Abundant Species

Stratum	Species
Tree canopy	*Acer grandidentatum, Quercus muehlenbergii*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is found frequently in this association, across life stages, and in relatively abundant populations. More generally it is found along streams and in moist canyons sporadically throughout the arid Southwest. The New Mexico population is considerably disconnected from the Arizona and Texas collections.

Penstemon cardinalis ssp. *cardinalis* is classified as a New Mexico rare plant that occurs occasionally in this association. Generally found on limestone slopes and canyon bottoms in lower montane coniferous forests, and in montane scrub, and piñon-juniper woodlands, it is known to exist in Eddy and Otero counties of New Mexico, and Hudspeth County, Texas.

Solidago wrightii var. *guadalupensis* is classified as a New Mexico rare plant that occurs occasionally in this association. Generally, it is found on limestone outcrops and substrates in Chaves and Eddy counties, New Mexico, and in Culberson County, Texas.

Nama xylopodum is classified as a New Mexico rare plant, and is scarce in this association. Generally it can be found in Eddy, Otero, and Chaves counties in New Mexico, and in El Paso and Culberson counties of Texas in the Franklin and Guadalupe mountains.

Polypogon viridis, a non-native introduced species, is an infrequent associate, growing near one of the sites in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC180, 06YC187, 06YC190, 06YC200, 06YC225, 07CJ007, 07YC012, 08GM004, 08GM006, 08CJ022, 10EL044, 10CJ074
Local Description Authors: H. Varani and E. H. Muldavin

***Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii* Forest**
Southwestern White Pine - Bigtooth Maple - Knowlton's Hophornbeam Forest (Table C39)

Identifier: CEPP006984

Table C39. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii* Forest

Distribution
This uncommon association is known to occur in the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
Located in drainages and valley bottoms at 7,261and 7,573 ft (2,214 and 2,310 m), this association can be found at sites of moderate slopes with variable aspects. Herbaceous groundcover is very sparse; ground surfaces are generally concealed by litter with some rock exposure. Geologic substrate for both sites is the Carlsbad Limestone.

Soils are mapped as the Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed canopy of this forest association is dominated by *Pinus strobiformis*, with *Ostrya knowltonii* as codominate (Table C40). *Acer grandidentatum* is also present, and can dominate the shrub layer, which varies in density and may include the shrub *Holodiscus dumosus* or snowberries (*Lonicera* spp.), and the subshrub *Mahonia repens*. The forb *Aletes filifolius* is the only recorded species in the very sparse herbaceous layer.

Table C40. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis, Ostrya knowltonii, Acer grandidentatum*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. In this association, it is very abundant, and codominant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ069, 10EL042
Local Description Authors: H. Varani

***Pinus strobiformis - Acer grandidentatum - Quercus gambelii* Forest**
Southwestern White Pine - Bigtooth Maple - Gambel Oak Forest (Table C41)

Identifier: CEPP006985

Table C41. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pinus strobiformis - Acer grandidentatum - Quercus gambelii* Forest

Distribution
This uncommon association is known to occur in the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
Located in drainages and coves, examples of this association are located at 7,741 and 7,759 ft (2,361 and 2,367 m). Sites are on gentle slopes that vary in aspect, and both are rocky with ground surfaces largely concealed by litter. Geologic substrates are the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that forest soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed canopies of this forest association are codominated by *Pinus strobiformis* and *Acer grandidentatum* (Table C42). Some stands may include *Pseudotsuga menziesii* in abundance. Subcanopies are dominated by young specimens of *Acer grandidentatum*, and *Pseudotsuga menziesii* and may reach 40% cover. The shrub layer is dominated by *Quercus gambelii* with few other shrub including *Fendlera rupicola* and tree regeneration. Four species (one grass, three forbs) are recorded in the sparse herbaceous layer, which may be absent or cover a percent or two.

Table C42. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis, Acer grandidentatum*
Shrub canopy	*Quercus gambelii*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. In this association, it occurs at one of the two sites. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ071, 10EL068
Local Description Authors: H. Varani

***Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii* Forest**
Southwestern White Pine - Bigtooth Maple - Chinkapin Oak Forest (Table C43)

Identifier: CEPP006986

Table C43. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii* Forest

Distribution
This uncommon association is known to occur in the Mountain High Country area of Guadalupe Mountains NP, just northwest of The Bowl.

Environmental Description
Occurring at relatively high elevations between 7,177 and 7,358 ft (2,187 and 2,243 m), this forest association can be found on moderate slopes extending into drainages with southwesterly aspects. Ground surfaces are predominantly concealed by litter, and may be rocky or gravelly. Geologic substrates are the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This forest association's closed canopies are dominated by *Pinus strobiformis*. *Acer grandidentatum* and *Quercus muehlenbergii* are both abundant components (Table C44), and *Pseudotsuga menziesii* is well-represented. *Ostrya knowltonii* is often present. The subcanopy can be absent or as much as 60% cover and is composed primarily of *Acer grandidentatum* regeneration, occasionally including young *Ostrya knowltonii* and/or *Arbutus xalapensis*. Shrubs, *Quercus gambelii*, *Cercocarpus montanus* and *Robinia neomexicana*, are scattered where they occur; no subshrubs occur. Forbs and grasses are similarly scarce, or absent.

Table C44. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis, Acer grandidentatum, Quercus muehlenbergii*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It occurs frequently in this association, with an average cover approaching 5%, and regeneration of this species can be abundant in the shrub layer. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10EL048, 10EL047
Local Description Authors: H. Varani

***Pinus strobiformis - Quercus muehlenbergii* Forest**
Southwestern White Pine - Chinkapin Oak Forest (Table C45)

Identifier: CEPP006987

Table C45. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pinus strobiformis - Quercus muehlenbergii* Forest

Distribution
This infrequent association is known to occur in the Mountain High Country area of Guadalupe Mountains NP, just northwest of The Bowl.

Environmental Description
This association can be found at 7,400 ft (2,257 m) on a gentle, west-facing ridge between converging drainage channels, and on a moderately sloped shelf above a drainage. Both site feature some rock (reaching 15% cover), though litter generally conceals the ground surfaces (as much as 80% cover). Geologic substrates are of the Capitan Limestone.

Soils for this site are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls or loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed canopies at these sites are dominated by *Pinus strobiformis*, with *Quercus muehlenbergii* as a codominant, or as a very abundant component (Table C46). The open subcanopy is dominated by regeneration of *Pseudotsuga menziesii* and/or *Quercus gambelii* and can include regeneration of *Pinus strobiformis*. The herbaceous understory is sparse. One site includes less than 10% total grass cover represented mostly by *Muhlenbergia montana*, with some *Festuca arizonica*, and a small amount of *Andropogon gerardii*. At the other site, only the forb *Frasera speciosa* is present, and scarce. This association can have a *Pinus ponderosa* phase, where dominance is shared between the nominal species and *Pinus ponderosa*.

Table C46. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis, Quercus muehlenbergii,* occasionally *Pinus ponderosa*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10EL047, 10EL048
Local Description Authors: H. Varani

***Pinus strobiformis / Festuca arizonica* Forest**
Southwestern White Pine / Arizona Fescue Fores (Table C47)

Identifier: CEPP006988

Table C47. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pinus strobiformis / Festuca arizonica* Forest

Distribution
This uncommon association is known to occur near The Bowl and Bush Mountain in the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
Occurring at relatively high elevation between 7,680 and 7,965 ft (2,340 and 2,559 m), this association can be found on gentle to moderate northeasterly slopes and ridge-tops. Sites are colluvial with ground surfaces featuring up to 10% rock cover, the vegetated interspaces generally concealed by litter (as much as 40%). Geologic substrates include the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The canopy of this forest association does not exceed 50%, and is most often dominated by *Pinus strobiformis* (Table C48) though sometimes *Pseudotsuga menziesii* is codominant. *Pinus ponderosa* is a common associate. Regeneration of these species act as primary components of the subcanopy, which can be absent or as much as 30%. Among the young trees. *Quercus gambelii*, *Symphoricarpos* spp., *Lorandersonia* spp. and *Philadelphus microphyllus* are scattered in the shrub understory. The herbaceous understory is very abundant to luxuriant, primarily consisting of grasses. The dominant is *Festuca arizonica*, sometimes codominant with *Muhlenbergia pauciflora* and/or *Panicum bulbosum*. Other occasionally well-represented species are *Achnatherum lobatum* and *Muhlenbergia dubia*. A total of a dozen forb species have been recorded in this association. These are variable and include *Allium cernuum* and *Lithospermum multiflorum* most commonly, though *Hieracium fendleri* and peavines (*Lathyrus* spp.) occur in more sizeable populations.

Table C48. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis*
Herb	*Festuca arizonica*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ061, 08CJ081, 10EL067
Local Description Authors: H. Varani

***Populus tremuloides - Pinus strobiformis / Ostrya knowltonii* Forest**
Quaking Aspen - Southwestern White Pine / Knowlton's Hophornbeam Forest (Table C49)

Identifier: CEPP006991

Table C49. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Populus tremuloides - Pinus strobiformis / Ostrya knowltonii* Forest

Distribution
This uncommon association is known to occur in the Mountain High Country area of Guadalupe Mountains NP near the northern rim of Pine Spring Canyon.

Environmental Description
This association is observed on slopes leading to drainages at 7,641 and 7,647 ft (2,331 and 2,333 m). Sites are moderate in gradient, and of variable aspects and include large boulders and rock, around which litter accumulates. Geologic substrates are the Capitan Limestone.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed canopy of this forest association is composed of several tree species. *Pinus strobiformis* shares dominance with *Ostrya knowltonii*, and *Populus tremuloides*(Table C50). Regeneration of each species is apparent. Other trees observed at the sites include *Acer grandidentatum*, and *Pseudotsuga menziesii*, but these may be incidental components. Understories are sparse. Shrubs are poorly represented, and include *Quercus gambelii*, *Frangula betulifolia*, and potentially *Amelanchier utahensis*, *Fendlera rupicola*, *Lonicera albiflora* or the subshrub *Mahonia repens*. The herbaceous layer is of one scattered grass species (*Bromus frondosus*) and four scattered forb species (*Asplenium resiliens*, *Galactia wrightii*, *Pseudostellaria jamesiana*, *Pseudocymopterus* spp.).

Table C50. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus strobiformis, Populus tremuloides, Ostrya knowltonii*

Other Noteworthy Species

Ostrya knowltonii is recognized by Flora of North America (1993+) as a rare plant. It can be very abundant in this association, where it occurs. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ072, 08CJ073.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii* Forest**

Douglas-fir - Bigtooth Maple - Knowlton's Hophornbeam Forest (Table C51)

Identifier: CEPP006993

Table C51. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii* Forest

Distribution

This infrequent association is known to occur in the Mountain High Country and McKittrick Canyon areas of Guadalupe Mountains NP.

Environmental Description

This association is found at 7,233 and 7,680 ft (2,204 and 2,340 m) on variable slopes. Sites have sparse herbaceous cover, and ground surfaces are rocky, or concealed by litter. Geologic substrates are of the Carlsbad Limestone, with one site occurring on the sandstone member of this formation.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

This forest association's open to closed canopies include *Acer grandidentatum* and *Pseudotsuga menziesii* as dominants, subdominated by *Ostrya knowltonii* (Table C52). Understory shrubs and subshrubs are abundant at one observed site, and absent at the other. Each of the five recorded species does not exceed 5% cover; these include *Frangula betulifolia* ssp. *obovata*, *Lonicera albiflora*, *Symphoricarpos oreophilus*, *Nolina texana*, and *Mahonia repens*. Herbaceous understories are sparse or absent and most likely include minute amounts of *Muhlenbergia dubia* or deer sedges (*Carex* spp.).

Table C52. Most Abundant Species

Stratum	Species
Tree canopy	*Acer grandidentatum, Pseudotsuga menziesii, Ostrya knowltonii.*

Other Noteworthy Species

Ostrya knowltonii is recognized by Flora of North America (1993+) as a rare plant. In this association, it is subdominant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM113, 10CJ065.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii* Forest**

Douglas-fir - Bigtooth Maple - Gambel Oak Forest (Table C53)

Identifier: CEPP006994

Table C53. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii* Forest

Distribution

This common association is scattered through the Mountain High Country and McKittrick Ridge areas of Guadalupe Mountains NP.

Environmental Description

This association can be found from 7,254 to 7,833 ft (2,211 to 2,388 m) on colluvial slopes of variable aspects (most commonly east or northeast). Sites are moderate to steep, and rocky or concealed by litter. The geologic substrate for all sites is the Carlsbad Limestone.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), forestland soils that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

The luxuriant tree canopies of this forest association can reach 80% cover and are formed by a combination of species, predominantly *Pseudotsuga menziesii*, and *Acer grandidentatum* (Table C54), and commonly *Ostrya knowltonii*, and *Pinus strobiformis*. The shrub layer is dominated by *Quercus gambelii*, regeneration of these species also generally dominates the shrub canopy, which averages 25% cover (*Philadelphus microphyllus*, *Fendlera rupicola*, *Robinia neomexicana*, and *Amelanchier utahensis* might also be included). Graminoids in the understory can reach 30% cover, but are generally poorly represented, and consist of a variety of six species, with *Muhlenbergia pauciflora* as the most commonly occurring and *Muhlenbergia dubia* as occasionally abundant. Forbs similarly can reach 15% cover

but are also generally poorly represented, and vary among 25 recorded species with *Frasera speciosa* as the most commonly occurring.

Table C54. Most Abundant Species

Stratum	Species
Tree canopy	*Pseudotsuga menziesii, Acer grandidentatum*
Shrub canopy	*Quercus gambelii, Acer grandidentatum*

Other Noteworthy Species

Ostrya knowltonii is recognized by Flora of North America (1993+) as a rare plant. In this association it occurs repeatedly and varies from being well-represented to very abundant where it occurs. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Solidago wrightii var. *guadalupensis* is classified as a New Mexico rare plant that is infrequently scattered in this association. It is generally found on limestone outcrops and substrates in Chaves and Eddy counties, New Mexico, and in Culberson County, Texas.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC206, 06YC223, 10CJ058, 10CJ064, 10EL019, 10EL059.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii* Forest**

Douglas-fir - Bigtooth Maple - Chinkapin Oak Forest (Table C55)

Identifier: CEPP006995

Table C55. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii* Forest

Distribution

This common association is scattered through the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description

This association is found on lower colluvial slopes within the elevation range of 6,719 to 7,765 ft (2,047 to 2,367 m). Sites can be steep and feature some rock, but litter generally conceals ground surfaces (averaging 70% cover). Geologic substrates are the Carlsbad and Capitan Limestones.

All sites are mapped with soils as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) which are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

The closed canopies of this forest association are most often dominated by *Pseudotsuga menziesii*, with abundant cover of *Quercus muehlenbergii* (Table C56). Subdominance is regularly shared between *Acer grandidentatum* and *Ostrya knowltonii*. Several other tree species may be present, most often *Pinus strobiformis* but occasionally *Juniperus deppeana* and *Juniperus scopulorum* are abundant. *Quercus gambelii* dominates the abundant to luxuriant shrub canopy with regeneration of the tree species, especially of *Acer grandidentatum*. Other shrubs may also be present, but vary among the 18 recorded species (such as *Fendlera rupicola*, *Ptelea trifoliate*, and *Robinia neomexicana*) and subshrubs are usually absent but might include *Mahonia repens* or *Agave parryi* ssp. *neomexicana*. The herbaceous layer is sparse. There are a dozen recorded grass associates that generally cover 5% or less; these include *Muhlenbergia pauciflora*, *Bromus frondosus*, or *Piptochaetium fimbriatum*. Though forbs are usually absent, they can be diverse with 27 recorded forb associates (some of the most common are *Artemisia ludoviciana*, *Allium cernuum*, and *Frasera speciosa*).

Table C56. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii, Quercus muehlenbergii, Acer grandidentatum*
Shrub Canopy	*Acer grandidentatum*

Other Noteworthy Species

Ostrya knowltonii is recognized by Flora of North America (1993+) as a rare plant. In this association, it is frequently well represented to very abundant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC216, 07CJ021, 10CJ028, 10CJ039, 10CJ046, 10CJ060, 10EL041.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Ostrya knowltonii* Forest**

Douglas-fir - Knowlton's Hophornbeam Forest (Table C57)

Identifier: CEPP006996

Table C57. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Ostrya knowltonii* Forest

Distribution

This common association is scattered through the Mountain High Country area and on Guadalupe Peak in Guadalupe Mountains NP.

Environmental Description

This association can be found across north to northeastern colluvial slopes within the relatively high elevation range of 7,365 to 8,488 ft (2,245 to 2,587 m). Sites are commonly rocky with ground surfaces concealed by litter. Geologic substrates are of the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH). These are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

The closed canopies of this forest are dominated by *Ostrya knowltonii* and codominated by *Pseudotsuga menziesii* (Table C58). Commonly included, *Pinus strobiformis* varies widely in abundance. *Quercus gambelii* dominates the abundant shrub canopy, typically with abundant tree regeneration. The shrub layer is diverse with 14 other species of shrubs and four species of subshrubs recorded; however, none break 5% cover. Shrubs include *Holodiscus dumosus*, *Philadelphus microphyllus*, and *Yucca baccata*. The herbaceous layer is usually poorly represented; forbs might include *Heuchera rubescens*, *Thalictrum fendleri*, and *Lithospermum multiflorum* and grass species may include bromes (*Bromus* spp.), little awn needlegrass (*Achnatherum lobatum*) and deer sedges (*Carex* spp.).

Table C58. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii, Ostrya knowltonii*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is the dominant and a nominal species of this association, and is very abundant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM077, 07CJ028, 08CJ041, 08CJ044, 10CJ012, 10CJ032, 10CJ044, 10CJ068.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest**

Douglas-fir - Southwestern White Pine - Gambel Oak Forest (Table C59)

Identifier: CEPP006997

Table C59. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest

Distribution
This very common association is scattered through the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
Occurring at the higher elevations of the Guadalupe Mountains, this association can be found between 7,311 and 8,232 ft (2,228 and 2,510 m). It is found on moderate to very steep rocky slopes with northern aspects, litter covers much of the vegetated interspaces (averaging more than 65%). Geologic substrates predominantly include the Capitan and Carlsbad Limestones.

All soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), forestland soils that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustoll Victorio series and the loamy-skeletal, mixed, superactive, mesic Lithic Haplustoll Lozen series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This forest association is characterized by dense tree canopies, averaging 50% tree cover. This is composed predominantly of *Pseudotsuga menziesii* and *Pinus strobiformis* (Table C60). The tall shrub *Quercus gambelii* dominates the shrub layer with sapling tree regeneration. Diverse other shrubs are present (29 species), most often including *Amelanchier utahensis*, *Holodiscus dumosus*, *Lonicera* spp., *Physocarpus monogynus*, *Ptelea trifoliata*, *Robinia neomexicana*, *Rosa stellata*, *Symphoricarpos* spp. and the subshrub *Mahonia repens*. Of the generally sparse herbaceous understory, the grasses *Festuca arizonica*, *Achnatherum lobatum*, *Muhlenbergia pauciflora*, and upland Carices are found the most frequently. *Panicum bulbosum* occurs also, and covers notable proportions of the herbaceous layer where it exists. A variety of forbs (45 species) are scattered in this association, most frequently found are *Lithospermum multiflorum* and *Allium cernuum*.

Table C60. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii, Pinus strobiformis, Quercus gambelii*
Shrub Canopy	*Pinus strobiformis, Quercus gambelii*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is frequently abundant in this association, across life stages. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Bromus inermis is an introduced species found repeatedly in this association, but with low cover values.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC215,08CJ060, 08CJ063, 08CJ066, 08CJ069, 08CJ070, 08CJ071, 08CJ077, 08CJ083, 08CJ085, 08CJ086, 08CJ087, 08CJ089, 08CJ091, 08CJ092, 10CJ001, 10CJ002, 10CJ004, 10CJ005, 10CJ006, 10CJ008, 10CJ022, 10CJ023, 10CJ030, 10CJ034, 10CJ047, 10CJ059, 10CJ061, 10CJ067, 10EL005, 10EL006, 10EL007, 10EL009, 10EL010, 10EL011, 10EL028.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica* Forest**
Douglas-fir - Gambel Oak / Arizona Fescue Forest (Table C61)

Identifier: CEPP006998

Table C61. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica* Forest

Distribution
This very common association is found in the Mountain High Country area, near the northern rim of Pine Springs Canyon in Guadalupe Mountains NP.

Environmental Description
This association is found on colluvial slopes within the elevation range of 7,631 to 8,400 ft (2,326 to 2,430 m). Sites are on gentle to moderate northerly slopes, and can be rocky or bare, with patches of litter in vegetation interspaces. Geologic substrates are the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), which are forest soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The tree canopy of this forest association ranges from 20% to 80% cover and is dominated by *Pseudotsuga menziesii* (Table C62) with *Pinus strobiformis* also common to abundant. *Quercus gambelii* dominant in the shrub layer. Regeneration of tree species is evident and abundant in shrub canopy. Of the seven other variable shrubs, *Robinia neomexicana* is the most often encountered, and at one site *Quercus* × *pauciloba* composed 40% of the shrub canopy cover. The understory is dominated by graminoids which can range from 10-60% cover and is dominated by *Festuca arizonica*. Other graminoid species include *Muhlenbergia pauciflora*, *Muhlenbergia dubia*, *Achnatherum lobatum*, *Koeleria macrantha*, *Piptochaetium pringlei*, *Schizachyrium scoparium*, and deer sedges (*Carex* spp.). At one site *Muhlenbergia setifolia* is very abundant. Forbs (usually absent and rarely reaching 10% cover) most commonly include *Lithospermum multiflorum*, *Frasera speciosa*, *Achillea millefolium*, and *Allium cernuum*.

Table C62. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii*
Shrub Canopy	*Quercus gambelii*
Herb	*Festuca arizonica*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It infrequently occurs in this association, and is poorly represented. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Bromus inermis is an introduced species found poorly represented at one site in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ075, 08CJ090, 08CJ094, 10CJ003, 10CJ027, 10EL022, 10EL066, 10EL069, 10EL070, 10EL071.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest**
Douglas-fir - Gambel Oak / New Mexico Muhly Forest (Table C63)

Identifier: CEPP006999

Table C63. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest

Distribution
This common association is scattered through the southern parts of the Mountain High County area of Guadalupe Mountains NP.

Environmental Description
This association is found within the elevation range of 7,431 to 8336 ft (2,265 to 2,541 m) on moderate to steep colluvial slopes with northern aspects. Sites feature patches of litter and exposed rock in the vegetation interspaces. Geologic substrates include the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), which are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The tree canopies of this forest association range from open to closed, and are dominated by *Pseudotsuga menziesii* (Table C64) and commonly include *Pinus ponderosa* and small amounts of *Pinus strobiformis*, *Juniperus deppeana*, and *Ostrya knowltonii*. Shrub canopy is cover also variable in cover, but is typically abundant and dominated by *Quercus gambelii*. Of the 14 other shrub species in this association, *Yucca torreyi* is the most common, *Philadelphus microphyllus* is occasionally well represented, and *Quercus* × *pauciloba* can be dense where it occurs. Sapling trees are well represented to abundant in the shrub layer. The grassy understory is rarely less than 30% cover and is dominated by diagnostic grass *Muhlenbergia pauciflora* and regularly includes *Festuca arizonica*. The 15 other associated grass species vary, as do most of the 41 recorded forbs. Other common grasses include *Achnatherum lobatum*, *Muhlenbergia dubia*, *Muhlenbergia setifolia*, *Panicum bulbosum*, and *Piptochaetium fimbriatum*. Forb cover is generally less than 5% (but can be as much as 10%) most often including *Lithospermum multiflorum*, and repeatedly including *Artemisia ludoviciana*, *Allium cernuum*, *Linum lewisii*, and *Mirabilis oxybaphoides*.

Table C64. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii*
Shrub Canopy	*Quercus gambelii*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is found occasionally in this association, but does not exceed 15% cover. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Ribes mescalarium is classified as a New Mexico rare plant. In this association it can be well represented where it occasionally occurs, Generally, *Ribes mescalarium* can be found on dry slopes in montane, coniferous forests and is known to exist in the Sacramento and Guadalupe mountains of Lincoln and Otero counties, New Mexico, and Culberson county, Texas.

Verbascum thapsus, an introduced biennial species, is an infrequent associate.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC217, 08CJ062, 08CJ074, 08CJ076, 08CJ093, 08CJ096, 10CJ013, 10EL024, 10EL058.
Local Description Authors: H. Varani

***Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatu*m Forest**

Douglas-fir - Gambel Oak / Pinyon Ricegrass Forest (Table C65)

Identifier: CEPP007000

Table C65. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum* Forest

Distribution

This common association occurs in the Mountain High Country area of Guadalupe Mountains NP, generally near The Bowl, with examples occurring on Blue Ridge and the west rim of South McKittrick Canyon as well.

Environmental Description

This association can be found within the relatively high elevations of 7,428 to 7,803 ft (2,263 to 2,475 m). Sites are not particularly rocky and occur on gentle to moderate colluvial slopes of variable aspect. Patches of litter conceal vegetation interspaces. Geologic substrates are the Carlsbad Limestone, with one site on the sandstone member of this formation.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

Tree canopies of this forest association are luxuriant and dominated by *Pseudotsuga menziesii* (Table C66) with *Pinus strobiformis* present to codominant. Other trees may include *Pinus ponderosa*, *Juniperus deppeana*, *Juniperus scopulorum* and *Ostrya knowltonii*. *Quercus gambelii* dominates the typically abundant to very abundant shrub canopy. Sapling trees, especially *Pseudotsuga menziesii* are well represent in the shrub canopy. Of the nine other shrub species, *Robinia neomexicana* is the most frequently encountered, followed by *Lonicera albiflora*, *Prunus serotina*, and *Symphoricarpos* spp. The herbaceous understory is grass dominated which can be abundant to very abundant (with one unusual site featuring only 5% grass cover). *Piptochaetium fimbriatum* is the most common and diagnostic dominant, occasionally codominant with *Festuca arizonica*, or *Piptochaetium pringlei*. Forbs rarely exceed 5% but are also rarely absent in this association; they frequently include *Frasera speciosa* and/or *Geranium caespitosum*.

Table C66. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii*
Shrub Canopy	*Quercus gambelii*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is infrequent in this association. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10EL017, 10EL018, 10EL014, 10CJ018, 06EM085.
Local Description Authors: H. Varani

***Pseudotsuga menziesii / Muhlenbergia pauciflora* Forest**

Douglas-fir / New Mexico Muhly Forest (Table C67)

Identifier: CEPP007098

Table C67. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.1)
Division	Madrean-Balconian Forest & Woodland (1.B.1.Nd)
Macrogroup	Madrean Montane Forest & Woodland (M011)
Group	Madrean Upper Montane Conifer - Oak Forest & Woodland [G202]
Association	*Pseudotsuga menziesii / Muhlenbergia pauciflora* Forest

Distribution

This common association exists in Guadalupe Mountains NP on Guadalupe Peak, and is scattered in the Mountain High Country area (specifically, it is present on Blue Ridge and the north rim of South McKittrick Canyon).

Environmental Description

This association occurs within the elevation range of 7,648 to 8,417 ft (2,331 to 2,566 m) on moderate to steep colluvial slopes. Sites generally have northern aspects, and feature grassy understories interspersed with patches of litter and some rock. Geologic substrates are the Carlsbad and Capitan Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH) which are forestland soils made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description

The open to closed tree canopies of this forest association are dominated by *Pseudotsuga menziesii* (Table C68), feature *Pinus ponderosa* and occasionally include *Pinus strobiformis*, and *Pinus ponderosa*. One site includes heavy cover of *Juniperus deppeana* (29% cover). The understory of this association is 30% to 50% grass cover, dominated by the nominal species, *Muhlenbergia pauciflora*. Deer sedges (*Carex* spp.), *Muhlenbergia dubia*, and *Piptochaetium fimbriatum* are also repeated herbaceous elements, with one site featuring abundant cover of *Bromus frondosus*. Regeneration of the aforementioned tree species and the shrub *Quercus gambelii* contribute to the variable, but typically low shrub canopy. Usually, shrub cover does not exceed 10%, but one unusual site has 40% mixed shrub cover. Commonly included shrubs are *Yucca baccata* and less frequently, *Philadelphus microphyllus*, and common subshrubs include *Gymnosperma glutinosum* and *Mahonia repens*. In the herbaceous layer, 13 species of forbs contribute to the average of 2.5% total forb cover; these occasionally dominated by *Lithospermum multiflorum* or *Oxalis drummondii*.

Table C68. Most Abundant Species

Stratum	Species
Tree Canopy	*Pseudotsuga menziesii*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It can occur in this association, but usually does not contribute substantially to cover values. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM078, 06EM083, 08CJ035, 08CJ038, 10CJ035.
Local Description Authors: H. Varani

G222. Rocky Mountain Subalpine - Montane Aspen Forest & Woodland Group

***Acer grandidentatum / Quercus gambelii* Forest**
Bigtooth Maple / Gambel Oak Forest (Table C69)

Identifier: CEGL000559

Table C69. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Cool Temperate Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.2)
Division	Rocky Mountain Temperate Forest & Woodland (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine - High Montane Forest (M020)
Group	Rocky Mountain Subalpine - Montane Aspen Forest & Woodland Group [G222]
Association	*Acer grandidentatum / Quercus gambelii* Forest

Distribution
This common association is scattered, occurring in the Mountain High Country area and South McKittrick Canyon of Guadalupe Mountains NP.

Environmental Description
This association is found within the elevation range of 5,509 to7,686 ft (1,679 to 2,343 m) in drainages and valley bottoms. Sites can climb steep slopes, and are very rocky with sparse herbaceous cover and abundant litter accumulation. Geologic substrates are the Capitan and Carlsbad Limestones.

Soils are mapped predominantly as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH), these are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls. Soil at one site is mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH), which are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description
The closed canopies of this forest association are dominated by *Acer grandidentatum (*Table C70), *Arbutus xalapensis* is common, and where it occurs *Ostrya knowltonii* is well represented. The open to moderate shrub layer is dominated by *Quercus gambelii* with sapling regeneration of *Acer grandidentatum*, but include a variety of 11 shrubs. The most consistently occurring of these is *Dasylirion leiophyllum*. Herbaceous cover is low and averages 4% and including six grass species, and four scattered forbs. Either life form may be absent; *Muhlenbergia pauciflora* is the most abundant and common.

Table C70. Most Abundant Species

Stratum	Species
Tree canopy	*Acer grandidentatum*
Shrub canopy	*Quercus gambelii*

Other Noteworthy Species
Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is occasionally well represented in this association. More generally it is found along streams and in moist canyons sporadically throughout the arid Southwest. The New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08SS017, 08SS020, 10CJ043, 10CJ048, 10EL065.
Local Description Authors: H. Varani

G229. Southern Rocky Mountain Ponderosa Pine Open Woodland Group

***Pinus ponderosa - Quercus gambelii / Festuca arizonica* Forest**
Ponderosa Pine - Gambel Oak / Arizona Fescue Forest (Table C71)

Identifier: CEPP006979

Table C71. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Cool Temperate Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.2)
Division	Rocky Mountain Temperate Forest & Woodland (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Southern Rocky Mountain Ponderosa Pine Open Woodland Group [G229]
Association	*Pinus ponderosa - Quercus gambelii / Festuca arizonica* Forest

Distribution
This infrequent association is known to occur in The Bowl of the Mountain High County area in Guadalupe Mountains NP.

Environmental Description
This association occurs at 7,950 ft (2,423 m) on a gentle, east-facing, colluvial mid-slope. The site features some limestone rock and patches of litter and grass. Geologic substrate is of the Carlsbad Limestone.

The soil for this site is mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG). Soils such as this are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls or loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This site features a very abundant tree canopy (40% cover) codominated by *Pinus ponderosa* and *Quercus gambelii (*Table C72), regularly including *Pinus strobiformis* in small amounts (less than 5% cover). The 10% shrub cover is dominated by *Juniperus deppeana* regeneration and includes young individuals of *Quercus gambelii*. The very abundant herbaceous layer (40% grass cover, 5% forb cover) is dominated by *Festuca arizonica* and includes four other species of grass (*Muhlenbergia dubia*, *Muhlenbergia montana*, Muhlenbergia *wrightii*, and *Schizachyrium scoparium*). Forbs include three species (*Cirsium* spp., *Hymenoxys richardsonii*, and *Lithospermum multiflorum*) of which the most common are thistles, unidentifiable at the time of observation.

Table C72. Most Abundant Species

Stratum	Species
Tree Canopy	*Pinus ponderosa, Quercus gambelii*
Herb	*Festuca arizonica*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10EL023.
Local Description Authors: H. Varani

G253. Southern Rocky Mountain Pinyon - Juniper Woodland Group

***Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis* Open Woodland**
Two-needle Pinyon - (One-seeded Juniper, Alligator Juniper) / Blue Grama Open Woodland (Table C73)
Identifier: CEGL002151

Table C73. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Cool Temperate Forest & Woodland (1.B)
Formation	Warm Temperate Forest & Woodland (1.B.2)
Division	Western North American Pinyon - Juniper Woodland & Scrub (1.B.2.Nc)
Macrogroup	Southern Rocky Mountain - Colorado Plateau Two-needle Pinyon - Juniper Woodland (M027)
Group	Southern Rocky Mountain Pinyon - Juniper Woodland Group [G253]
Association	*Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis* Open Woodland

Distribution
This infrequent association is known from PX Flat area in Guadalupe Mountains NP.

Environmental Description
This association is found at 6,522 ft (1,987 m) elevation on a gentle slope (6%) with a 40 degree aspect. Sites is relatively xeric for woodland with higher cover of litter (30%) and soil surface (40%) cover and lower cover of gravel (15%) and rock (2%) that is typical for pinyon - juniper woodlands. The geologic substrate is the Carlsbad Limestone.

Soils are mapped as Lazarus loam, 2 to 9% slopes (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This woodland association is characterized by and open tree canopy (<30 % cover) that is codominated by *Pinus edulis*, *Juniperus monosperma* and/or *Juniperus deppeana* (Table C74). Grass in the understory is typically very abundant 25% depending on cover of woody vegetation. *Bouteloua gracilis* strongly dominants the herbaceous layer, although other grasses are present such as *Achnatherum lobatum*, *Aristida purpurea* var. *nealleyi*, *Bouteloua curtipendula*, and *Muhlenbergia setifolia* also contribute to grass cover. Shrub cover is typically low (< 10% cover) and includes scattered *Cylindropuntia imbricata*, *Mahonia haematocarpa*, *Nolina texana*, *Opuntia engelmannii*, and *Yucca baccata*. Subshrub, *Gutierrezia sarothrae* may be well represented depending on level of disturbance on site. Nine forbs are recorded; these species are scattered with low cover (< 5% total) with only *Melampodium leucanthum* and *Viguiera dentata* having more this 1% cover. This plot occurs in the southern extent of the range of this type and includes some Chihuahuan indicator species. *Bouteloua eriopoda* is more abundant outside the plot.

Table C74. Most Abundant Species

Stratum	Species
Tree canopy	*Pinus edulis, Juniperus monosperma, Juniperus deppeana*
Herb	*Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07PA015.
Local Description Authors: K.A. Schulz

G797. Western Interior Riparian Forest & Woodland

***Populus deltoides / Muhlenbergia asperifolia* Flooded Forest**
Eastern Cottonwood / Alkali Muhly Flooded Forest (Table C75)

Identifier: CEGL000678

Table C75. US National Vegetation Classification

Level	Unit
Class	Forest & Woodland (1)
Subclass	Cool Temperate Forest & Woodland (1.B)
Formation	Temperate Flooded & Swamp Forest (1.B.3)
Division	Western North American Interior Flooded Forest (1.B.2.Nd)
Macrogroup	Interior Warm & Cool Desert Riparian Forest (M036)
Group	Western Interior Riparian Forest & Woodland Group [G797]
Association	*Populus deltoides / Muhlenbergia asperifolia* Flooded Forest

Distribution
This infrequent association is known to occur at Bone Spring in the Western Escarpment area of Guadalupe Mountains NP.

Environmental Description
This association occurs at 5,436 ft (1,656 m) in a narrow, rocky drainage. The site includes the stream channel, which was flowing at the time of observation; the ground surface is largely impervious, 15% gravel and 30% rock. The geologic substrate for this site is the Brushy Canyon Formation.

Soils for this site are Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG); these soils are loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents (USDA NRCS and USDI NPS 2010).

Vegetation Description
The very open tree canopy (10% cover) of this forest association consists exclusively of *Populus deltoides* ssp. *wislizeni* at this site (Table C76). The understory is shrub dominated, the 35% shrub cover consisting of 23 shrub species. *Fallugia paradoxa* composes more than half of this canopy, followed by *Baccharis salicina*. Also exceeding 1% cover are the shrubs *Acacia neovernicosa*, *Brickellia californica*, *Forestiera pubescens* var. *pubescens*, *Opuntia engelmannii*, and the subshrub *Gutierrezia sarothrae*. Graminoids contribute 20% cover at this site, forbs contribute 7%. Of the

dozen graminoids, only *Muhlenbergia asperifolia* is abundant, though *Bothriochloa laguroides* ssp. *torreyana*, *Bouteloua curtipendula*, and *Juncus torreyi* all exceed 1% cover. Of the 20 forb species observed, only *Adiantum capillus-veneris*, *Equisetum laevigatum*, and *Viguiera dentata* exceed 1% cover.

Table C76. Most Abundant Species

Stratum	Species
Tree Canopy	*Populus deltoids*
Herb	*Muhlenbergia asperifolia*

Other Noteworthy Species

Ericameria nauseosus var. *texensis* is recognized by Flora of North America (1993+) as a rare plant that is scattered in at this site. Generally, this species prefers crevices on faces of limestone cliffs and huge boulders of canyon woodlands, less frequently occurring in open gravel alluvium of stream beds in piñon-juniper woodland and Chihuahuan desert scrub. In New Mexico it is known to occur in the Guadalupe and Brokeoff mountains of Eddy and Otero counties and in the adjacent Culberson County of Texas.

Perityle quinqueflora is recognized in New Mexico as a rare plant and is found growing near this site. It prefers crevices of limestone (rarely igneous) bluffs, cliffs in high canyons and caprock, and is known to occur in Eddy County of New Mexico, and Culberson, Hudspeth, Presidio, and western Jeff Davis counties of Texas.

Polypogon viridis (beardless rabbitsfoot), an introduced, perennial grass is recorded on site, but does not exceed 1%. Similarly *Cynodon dactylon* (bermudagrass), an introduced perennial grass is also associated with this site, found nearby.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC232.
Local Description Authors: H. Varani

G268. Southern Rocky Mountain Montane - Subalpine Grassland Group

***Festuca arizonica - Bouteloua gracilis* Grassland**

Arizona Fescue - Blue Grama Grassland (Table C77)

Identifier: CEPP006886

Table C77. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Rocky Mountain - Vancouverian Subalpine - High Montane Mesic Meadow (M168)
Group	Southern Rocky Mountain Montane - Subalpine Grassland Group [G268]
Association	*Festuca arizonica - Bouteloua gracilis* Grassland

Distribution

This infrequent association is known to occur in The Bowl of the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
This site occurs at 7,742 ft (2,360 m) on a gentle colluvial slope with a north/northeastern aspect. The ground surface features a small amount of litter interspersed into the luxuriant herbaceous cover that approaches 100%. Geologic substrate is of the Carlsbad Limestone.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
At this site, a combination of grasses and forbs contribute to a luxuriant herbaceous layer that approaches 100% cover. The single dominant species in this herbaceous association is the grass *Festuca arizonica* (Table C78). At this site, *Andropogon gerardii* is also an abundant component, and *Bouteloua gracilis* occurs, but forbs actually dominate the herbaceous layer through a combination of six species. *Chenopodium graveolens* and *Verbena macdougalii* are the major contributing species, but *Amaranthus retroflexus* and *Artemisia ludoviciana* ssp. *Mexicana* are also abundant, and a small amount of *Chamaesyce serpens*, and peavine (*Vicia* spp.) are present. Trees and shrubs do not occur at this site, but *Pinus ponderosa*, and *Juniperus deppeana* can be found nearby.

Table C78. Most Abundant Species

Stratum	Species
Herb	*Festuca arizonica, Bouteloua gracilis*

Other Noteworthy Species
Amaranthus retroflexus is an introduced annual species that was abundant at this site at the time of observation.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ078.
Local Description Authors: H. Varani

***Achnatherum lobatum - Bouteloua curtipendula* Grassland**
Little Awn Needlegrass - Sideoats Grama Grassland (Table C79)

Identifier: CEPP006871

Table C79. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Rocky Mountain - Vancouverian Subalpine - High Montane Mesic Meadow (M168)
Group	Southern Rocky Mountain Montane - Subalpine Grassland Group [G268]
Association	*Achnatherum lobatum - Bouteloua curtipendula* Grassland

Distribution
This infrequent association occurs in the Brokeoff Mountains, in the Basin and Range area of Guadalupe Mountains NP.

Environmental Description

Examples of this association can be found from 6,093 to 6,470 ft (1,857 to 1,972 m) on gentle to moderate, north facing slopes. Steeper sites are rockier with some gravel, while the gentlest site features some exposed soil and more litter cover. Geologic substrates are the Goat Seep and Carlsbad Limestones and younger alluvial deposits.

Soils are mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) and as Lazaus loam, 2 to 9% slope (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This grassland association is codominated by 40 to 60% cover of *Achnatherum lobatum* and *Bouteloua curtipendula* (Table C80). Ten other grass species vary between the three sites; *Eragrostis intermedia* is common, and at one site *Lycurus setosus* is abundant. Shrub cover can reach 30%; of the 19 recorded species, *Cercocarpus montanus* var. *paucidentatus* is consistently present, and *Nolina texana*, *Ceanothus greggii*, *Yucca baccata*, *Dasylirion leiophyllum*, *Opuntia engelmannii* and the subshrub *Gutierrezia sarothrae* are common. At one site, *Fallugia paradoxa* is well represented. Forbs are a minor component of this association, and none of the 18 species exceed 1%. They most often include *Linum vernale*, but commonly include *Eriogonum hieraciifolium*, *Paronychia jamesii*, *Viguiera dentata*, and *Giliastrum acerosum* as well. Trees are absent or represented by scattered individuals of *Pinus edulis*.

Table C80. Most Abundant Species

Stratum	Species
Herb	*Achnatherum lobatum, Bouteloua curtipendula*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ003, 07PA001, 07PA017.
Local Description Authors: H. Varani

G276 Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group

NVC Description: This Rocky Mountain foothill shrubland group ranges from southern New Mexico north into Wyoming, and west into the Intermountain West region. *Cercocarpus montanus* dominates pure stands in parts of Wyoming and Colorado. The vegetation is typically dominated by a variety of shrubs, including *Amelanchier utahensis*, *Cercocarpus montanus*, *Quercus* × *pauciloba*, *Purshia tridentata*, *Rhus trilobata*, *Ribes cereum*, *Symphoricarpos oreophilus*, or *Yucca glauca*. Grasses and sedges are dominant in the understory and may include *Achnatherum scribneri*, *Bouteloua curtipendula*, *Carex geyeri*, *Elymus lanceolatus*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus ambiguus*, *Muhlenbergia montana*, and *Pseudoroegneria spicata*. Scattered trees or inclusions of grassland patches or steppe may be present. Stands are found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. These shrublands occur between 4921 and 9514 ft (1500 and 2900 m) elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent, such as the northern Colorado Front Range and in drier foothills and prairie hills. This group is generally drier than Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group (G277), but may include mesic montane shrublands where *Quercus gambelii* does not occur. Fires play an important role in this group as the dominant shrubs usually

have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root-crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases, sites are too xeric for tree growth.

***Quercus x pauciloba / Cercocarpus montanus* Shrubland**

Wavyleaf Oak / Alderleaf Mountain-mahogany Shrubland (Table C81)

Identifier: CEGL001118

Table C81. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Southern Rocky Mountain Montane Shrubland (049)
Group	Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group [G276]
Association	*Quercus* x *pauciloba* / *Cercocarpus montanus* Shrubland

Distribution

This association is scattered through the Mountain High Country area of Guadalupe Mountains NP. It also occurs in the McKittrick Canyon and East Escarpment areas.

Environmental Description

This common association occurs most frequently on moderate to steep, colluvial slopes across a wide elevation range of 5,400 to 8,016 ft (1,645 to 2,443 m). Sites are rocky and gravely and are found across slope faces. Geologic substrates include the Carlsbad and Capitan Limestones.

Soils are mapped primarily as the Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH) These are clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls. Minor soil units include Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls) and Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association is characterized by dense shrub canopies and sparse, rocky understories. Shrub canopy dominance is shared between *Quercus* × *pauciloba* and *Cercocarpus montanus* var. *paucidentatus* (Table C82) and *Cercocarpus montanus* also occurs. A variety of 11 other shrubs appear, among the most common are *Nolina texana* and *Rosa stellata*. Tree cover is frequently absent though occasionally as much as 20%, and includes *Juniperus deppeana*, and *Pseudotsuga menziesii*. Grass cover is often less than 5%, and does not exceed 20%. The most frequent dominant is *Muhlenbergia pauciflora*, but alternative dominants are occasionally *Muhlenbergia dubia* or *Andropogon gerardii*. Forbs are a minor component of this association with *Linum lewisii*, *Lithospermum viride*, and *Polygala alba* as the only recorded species.

Table C82. Most Abundant Species

Stratum	Species
Shrub	*Quercus* × *pauciloba, Cercocarpus montanus* var. *paucidentatus*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ020, 08CJ030, 08GM007, 10EL015, 10EL039, 10EL040, 10EL064.
Local Description Authors: H. Varani

G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group

***Quercus gambelii / Carex inops* Shrubland**
Gambel Oak / Long-stolon Sedge Shrubland (Table C83)

Identifier: CEGL001112

Table C83. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Southern Rocky Mountain Montane Shrubland (049)
Group	Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group [G277]
Association	*Quercus gambelii / Carex inops* Shrubland

Distribution
This infrequent association is scattered in the Mountain High County area of Guadalupe Mountains NP.

Environmental Description
This association commonly occurs post-fire, and is known from gentle slopes in the elevation range of 7,599 to 8,222 ft (2,316 to 2,506 m). Sites vary in aspect, featuring up to 27% bare soil or rock, with litter concealing 50% or more of the ground surface. Geologic substrates are the Carlsbad Limestone.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association features 30% to 60% shrub cover, a layer dominated by *Quercus gambelii* (Table C84). Other shrub species (*Philadelphus microphyllus*, *Quercus* × *pauciloba*, *Cercocarpus montanus* and the subshrub *Mahonia repens*) are each observed at only one site in the association. Herbaceous layers can include up to 25% forb cover, commonly dominated by pea vine species, (*Lathyrus* spp.) but also including *Geranium caespitosum*, *Lithospermum multiflorum*, *Hymenopappus flavescens* var. *canotomentosus*, and *Vicia Americana*. Graminoid cover does not exceed 10% and includes *Muhlenbergia pauciflora* and deer sedges (*Carex* spp.). Tree cover in this association is more commonly absent, but may reach 50% and can include a variety of *Pinus ponderosa*, *Pseudotsuga menziesii*, *Ostrya knowltonii*, and/or *Pinus edulis*.

Table C84. Most Abundant Species

Stratum	Species
Shrub	*Quercus gambelii*
Herb	*Muhlenbergia pauciflora, Carex inops*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is well represented at one site in this association. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ029, 10CJ033, 10EL060.
Local Description Authors: H. Varani

Quercus gambelii / Piptochaetium fimbriatum - Festuca arizonica Woodland

Gambel Oak / Pinyon Ricegrass - Arizona Fescue Woodland (Table C85)

Identifier: CEPP007101

Table C85. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Southern Rocky Mountain Montane Shrubland (049)
Group	Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group [G277]
Association	*Quercus gambelii / Piptochaetium fimbriatum - Festuca arizonica* Woodland

Distribution

This infrequent association is found near Hunter Peak, on Blue Ridge, and in The Bowl of Guadalupe Mountains NP.

Environmental Description

This association is found within the elevations of 7,816 to 8,051 ft (2,382 to2,454 m) on gentle to moderate colluvial slopes. Ground surfaces at sites may be concealed by litter in the vegetated interspaces. Geologic substrates are the Carlsbad Limestone, with one site occurring on the sandstone member of this formation.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

The tree canopies of this woodland range from 30% to 70% cover, and are dominated by *Quercus gambelii* (Table C86). Of the four other recorded tree species, *Pinus ponderosa* and *Pseudotsuga menziesii* can be well represented. The understories are dominated by 25% graminoid cover, these dominated by *Piptochaetium fimbriatum* and codominated by *Festuca arizonica*. Forbs are commonly sparse but at one site, a 40% cover of *Artemisia ludoviciana* ssp. *Mexicana* dominates the understory. Shrubs and subshrubs are not a major component of the understory and do not exceed 10%. They can also be dominated by regeneration of *Quercus gambelii*, but may include the regeneration of the other tree species, and the shrub *Robinia neomexicana*.

Table C86. Most Abundant Species

Stratum	Species
Tree Canopy	*Quercus gambelii*
Herb	*Piptochaetium fimbriatum, Festuca arizonica*

Other Noteworthy Species
Bromus inermis, an introduced grass species, is poorly represented at one site in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM084, 06EM107, 10CJ017.
Local Description Authors: H. Varani

***Quercus gambelii / Robinia neomexicana* Shrubland**
Gambel Oak - New Mexico Locust Shrubland (Table C87)

Identifier: CEGL001115

Table C87. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Southern Rocky Mountain Montane Shrubland (049)
Group	Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group [G277]
Association	*Quercus gambelii / Robinia neomexicana* Shrubland

Distribution
This common association can be found in The Bowl and nearby on the ridge of the Eastern Escarpment of the Mountain High Country area of Guadalupe Mountains NP.

Environmental Description
This post-fire association is found from 7,796 to 8,171 ft (2,376 to 2,490 m). Sites occur on gentle to moderate slopes, with variable aspects. They can be rocky, but ground surfaces are generally concealed by litter, which covers 40%-70%. Geologic substrates are the Carlsbad Limestone.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) that are made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This post-fire shrubland features an always luxuriant shrub canopy (reaching 100% cover) codominated by *Robinia neomexicana* and short-statured *Quercus gambelii* (Table C88). Currants (*Ribes* spp.) and Snowberries (*Lonicera* spp.) might also appear. Forbs are generally more common than graminoids in the herbaceous layer, reaching 25% cover and commonly including geraniums, (*Geranium caespitosum*, *Geranium* spp.) and peavines, (*Lathyrus* spp.). Graminoids are often absent but can reach 15% cover; *Piptochaetium fimbriatum* is the only grass species that exceeds 1% where it occurs. Mature canopy trees generally don't occur in this association (scarcely including *Pseudotsuga menziesii*, *Pinus ponderosa* and *Pinus strobiformis*).

Table C88. Most Abundant Species

Stratum	Species
Shrub Canopy	*Quercus gambelii, Robinia neomexicana*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It can occur in this association but typically does not. It is generally found along streams and in moist canyons sporadically throughout the arid Southwest; the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Bromus inermis, an introduced grass, does not exceed 1% cover at one site in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ031, 10EL016, 10EL021, 10EL026, 10EL030.
Local Description Authors: H. Varani

***Robinia neomexicana / Piptochaetium fimbriatum* Shrubland**

New Mexico Locust / Pinyon Ricegrass Shrubland (Table C89)

Identifier: CEPP007155

Table C89. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Grassland & Shrubland (2.B.2.Na)
Macrogroup	Southern Rocky Mountain Montane Shrubland (049)
Group	Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group [G277]
Association	*Robinia neomexicana / Piptochaetium fimbriatum* Shrubland

Distribution

This association is known to occur in The Bowl of Guadalupe Mountains NP.

Environmental Description

This infrequent association occurs at 7,760 and 7,817 ft (2,365 and 2,400 m). Sites are on gentle slopes, with ground surfaces that are up to 72% concealed by litter, and may feature small patches of gravel or exposed soils among the herbaceous vegetation. Geologic substrates are of the Capitan and Carlsbad Limestones.

Soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG), made up of clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

This post-fire shrubland is dominated by *Robinia neomexicana* (Table C90), but shrub canopies may include the regeneration of *Pinus ponderosa* and/or *Quercus gambelii*. Herbaceous understories vary: grasses may be abundant, featuring *Piptochaetium fimbriatum* while forbs are poorly represented, or this association may exist in a ruderal phase, featuring little grass cover and a luxuriant cover of forbs, mainly *Artemisia ludoviciana* ssp. *Mexicana* but including *Geranium caespitosum*, *Verbascum thapsus*, *Verbena macdougalii,* and/or *Cirsium undulatum*. Mature canopy trees are not significant contributors to cover values.

Table C90. Most Abundant Species

Stratum	Species
Shrub	*Robinia neomexicana*
Herb	*Piptochaetium fimbriatum*

Other Noteworthy Species

Verbascum thapsus, an introduced biennial forb species, is poorly represented at one site in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10CJ014, 10CJ019.
Local Description Authors: H. Varani

G144. Great Plains Shortgrass Prairie Group

***Bouteloua gracilis - Bouteloua curtipendula* Grassland**
Blue Grama - Sideoats Grama Grassland (Table C91)

Identifier: CEGL001754

Table C91. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Central North American Grassland & Shrubland (2.B.2.Nb)
Macrogroup	Western Great Plains Shortgrass Prairie (M053)
Group	Great Plains Shortgrass Prairie Group [G144]
Association	*Bouteloua gracilis - Bouteloua curtipendula* Grassland

Distribution

This infrequent association can be found near Pine Spring in the Eastern Alluvial Uplands area of Guadalupe Mountains NP.

Environmental Description

This association is found within the elevation range of 5,559 to 5,715 ft (1,694 to 1,742 m) on gentle slopes with eastern and southeastern aspects. Ground surfaces at sites can be gravely, or substantially bare in the vegetated interspaces. Geologic substrates are older alluvial deposits, with one site on the Cherry Canyon Formation.

Soils are mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description

This grassland association is dominated by abundant to luxuriant cover of *Bouteloua gracilis* and includes *Bouteloua curtipendula* (Table C92) and a variety of 14 other grass species (*Panicum hallii* is abundant at one site). Forbs vary from site to site without any species occurring repeatedly. Of these, *Croton pottsii* is well represented at one site, and *Solanum elaeagnifolium* and *Xanthisma spinulosum* exceed 1%, but the other 20 species are scattered. Shrubs can exceed 10% cover when in a *Prosopis glandulosa* phase, and include *Mimosa aculeaticarpa* var. *biuncifera* and/or the subshrub *Gutierrezia sarothrae*. At the site where they occur, *Opuntia engelmannii*, *Quercus* × *pauciloba*, *Parthenium*

incanum, and *Opuntia phaeacantha* exceed 1%. Canopy trees are generally absent except when occurring in the *Juniperus pinchotii* phase. Even in this phase, trees are still generally represented by saplings, mature individuals are scattered.

Table C92. Most Abundant Species

Stratum	Species
Herb	*Bouteloua gracilis, Bouteloua curtipendula*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC010, 10TN008, 10TN009, 10TN012.
Local Description Authors: H. Varani

***Bouteloua gracilis* Ruderal Grassland**
Blue Grama Ruderal Grassland (Table C93)

Identifier: CEPP009501

Table C93. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Central North American Grassland & Shrubland (2.B.2.Nb)
Macrogroup	Western Great Plains Shortgrass Prairie (M053)
Group	Great Plains Shortgrass Prairie Group [G144]
Association	*Bouteloua gracilis* Ruderal Grassland

Distribution
This association occurs in the Guadalupe Pass area, along US 62/180, in Guadalupe Mountains NP.

Environmental Description
This site occurs at 5,695 ft (1,736 m) along a roadway. The site has little slope, and features small patches of litter (reaching 10% cover) among the dense herbaceous vegetation. Geologic substrates are of older alluvial deposits.

The soil unit for this site is Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description
At this site, this herbaceous association is dominated by forbs (totaling 60% cover). *Sphaeralcea incana* is the dominant of the 16 species, and covers more than 40% (Table C94); *Solanum elaeagnifolium* is well represented, *Cucurbita foetidissima* and *Euphorbia davidii* each exceed 1% cover. Of the five grass species, *Bouteloua gracilis* is abundant, *Setaria leucopila* is well represented, and *Bouteloua curtipendula*, *Muhlenbergia asperifolia*, and *Sporobolus cryptandrus* exceed 1% cover. Shrub and subshrubs are a minor component covering 3% of which only *Yucca elata* covers an excess of 1%. The other recorded species are *Cylindropuntia imbricata*, *Prosopis glandulosa*, *Opuntia engelmannii*, *Brickellia eupatorioides* var. *chlorolepis*, *Gutierrezia sarothrae*, and *Opuntia phaeacantha*. Trees do not occur at this site.

Table C94. Most Abundant Species

Stratum	Species
Herb	*Bouteloua curtipendula, Sphaeralcea incana*

Other Noteworthy Species
Euphorbia davidii and *Salsola tragus* are both introduced annual species. *Euphorbia davidii* exceeds 1% cover at this site while *Salsola tragus* is scarcely present.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM024.
Local Description Authors: H. Varani

***Bouteloua hirsuta - Bouteloua curtipendula* Grassland**
Hairy Grama - Sideoats Grama Grassland (Table C95)

Identifier: CEGL001764

Table C95. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Central North American Grassland & Shrubland (2.B.2.Nb)
Macrogroup	Western Great Plains Shortgrass Prairie (M053)
Group	Great Plains Shortgrass Prairie Group [G144]
Association	*Bouteloua hirsuta - Bouteloua curtipendula* Grassland

Distribution
This association occurs in West Dog Canyon, just south of the New Mexico/Texas border, in the northwest corner of Guadalupe Mountains NP.

Environmental Description
This association is found between 6,120 and 6,180 ft (1,865 and 1,884 m) elevation on alluvial terraces along dry wash channels.

Vegetation Description
This grassland is characterized by abundant to luxuriant *Bouteloua hirsuta*, with *Bouteloua curtipendula* as the main subdominant or codominant grass (Table C96) and *Aristida purpurea* a common associate. The shrub layer is poorly represented. Common shrub associates include *Mahonia haematocarpa* and *Fallugia paradoxa*. Forbs are uncommon, but *Paronychia jamesii* does occur.

Table C96. Most Abundant Species

Stratum	Species
Shrub	*Mahonia haematocarpa*
Herb	*Bouteloua hirsuta, Bouteloua curtipendula*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: GUMO_1851, GUMO_1869, GUMO_1890, GUMO_1891.
Local Description Authors: E. Muldavin

G281 Western Madrean Chaparral Group

NVC Description: This interior chaparral group is found across the southwestern United States from central New Mexico and southern Utah west to California. The moderate to dense evergreen shrub layer is dominated by sclerophyllous shrubs, especially *Ceanothus greggii* and *Quercus turbinella*. Other common shrubs from the eastern portion of its range (Arizona and New Mexico) include *Arctostaphylos pringlei* (higher elevations), *Arctostaphylos pungens*, *Cercocarpus montanus*, *Garrya wrightii*, *Purshia stansburiana*, *Quercus toumeyi*, and *Rhus trilobata*. In desert chaparral stands in the western extent *Arctostaphylos patula* (not dominant), *Arctostaphylos glauca*, *Cercocarpus montanus* var. *glaber* (= *Cercocarpus betuloides*), *Garrya flavescens*, *Juniperus californica*, *Nolina parryi*, *Quercus john-tuckeri*, *Quercus cornelius-mulleri, Quercus berberidifolia*, and *Rhus ovata* characterize this shrubland. Scattered remnant pinyon and juniper trees may be present; however, in the western Mojave, *Juniperus californica* sometimes forms an open, shrubby tree layer with the evergreen oaks and other shrubs. Stands occur prominently across central Arizona (Mogollon Rim) and western New Mexico, south into mountains in the northwestern Chihuahuan region and Madrean Occidental in northern Mexico, and north into extreme southwestern Utah and southern Nevada. It also occurs in mountains in the Sonora and western Mojave deserts, and extends from northeast Kern County, California, and south into Baja Norte, Mexico. Stands are found on foothills, xeric mountain slopes and canyons in hotter and drier habitats and often dominate along the mid-elevation transition zone between desert scrub and montane woodlands (3281-7218 ft; 1000-2200 m). Sites are often steep and rocky. Parent materials are varied and include basalt, diabases, gneiss, schist, shales, slates, sandstones and, more commonly, limestone and coarse-textured granitic substrates. Occasional desert scrub species may be present in drier, rockier, more open transition sites. Most chaparral species are fire-adapted, sprouting vigorously after burning or producing abundant fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

The similar Eastern Madrean Chaparral Group (G280) has floristics mostly derived from the Sierra Madre Oriental, whereas floristics of this group are derived from the Sierra Madre Occidental. However, this group is not mattoral (thornscrub) as it is typically dominated by shrubby evergreen oaks and chaparral species, not thornscrub species. More survey is needed to determine if *Quercus turbinella*, common in this group, also codominates in Eastern Madrean Chaparral Group (G280).

*Cercocarpus montanus / Muhlenbergia pauciflor*a Shrubland

Alderleaf Mountain-mahogany / New Mexico Muhly Shrubland (Table C97)

Identifier: CEGL001089

Table C97. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Western Madrean Chaparral Group [G281]
Association	*Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland

Distribution
This very common association is scattered through the Mountain High Country, Pine Spring Canyon and Guadalupe Peak areas of Guadalupe Mountains NP.

Environmental Description
This association is found on relatively high elevation, colluvial slopes tending to have southern aspects (elevations range from 6,496 to 8,332ft; 1,979 to 2,536 m). Sites are rocky with patches of litter and grass; they occur on ridge-tops, moderate to very steep slopes, and limestone escarpments. Geologic substrates include the Capitan, Carlsbad, and Goat Seep Limestones, with one site on the sandstone member of the Carlsbad Limestone.

Soils are mapped primarily as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls). Several sites are situated on Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), and one site is situated on Biduya-Desario-Rock outcrop complex soils, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls or loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association is characterized by variable shrub canopies (15% to 70% cover) encompassing 25 shrub species and grassy understories of 18 graminoids. Shrub cover is clearly dominated by *Cercocarpus montanus* var. *paucidentatus* (Table C98); other common shrubs include *Quercus* × *pauclioba*, *Ceanothus greggi*, and *Dasylirion leiophyllum*. Of the dozen subshrubs that occasionally appear, *Agave parryi* ssp. *neomexicana* is the most often scattered among the grasses and forbs. Grass cover ranges from 15% to 50%, and is clearly dominated by *Muhlenbergia pauciflora*, and commonly includes *Achnatherum lobatum*, *Eragrostis intermedia* and/or *Muhlenbergia emersleyi*. Occasionally, *Piptochaetium fimbriatum* or *Muhlenbergia dubia* are abundant components. Twenty-five forb species are scattered in the herbaceous layer, most frequently *Allium kunthii*; where it occurs, *Viguiera dentata* can exceed 1% cover. Mature canopy trees are generally absent, occasionally represented by *Juniperus deppeana*, *Pinus ponderosa*, *Pinus edulis* and/or *Arbutus xalapensis*.

Table C98. Most Abundant Species

Stratum	Species
Shrub	*Cercocarpus montanus var. paucidentatus*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM079, 06EM121, 06YC208, 06YC214, 06YC222, 06YC224, 07CJ018, 07CJ036, 08CJ021, 08CJ037, 08CJ040, 10CJ050, 10CJ051, 10CJ063, 10EL001, 10EL012.
Local Description Authors: H. Varani

G280 Eastern Madrean Chaparral Group

NVC Description: This chaparral group is found in mid-elevation sites in the Madrean Oriental in northern Mexico and desert mountains across Trans-Pecos Texas extending to the Guadalupe Mountains. It is characterized by a moderate to dense shrub canopy dominated by evergreen shrub oak species, such as *Quercus intricata*, *Quercus laceyi*, *Quercus pringlei*, *Quercus pungens*, and *Quercus vaseyana*, and several chaparral species, such as *Acacia roemeriana*, *Ceanothus greggii*, *Cercocarpus montanus*, *Dasylirion leiophyllum*, *Fallugia paradoxa*, and *Garrya wrightii*. Other Madrean species characteristic of this group include *Acacia roemeriana*, *Fendlera rigida* (= *Fendlera linearis*), *Fraxinus greggii*, *Garrya ovata*, *Juniperus pinchotii*, Purshia mexicana, *Rhus virens* var. *choriophylla* (= *Rhus choriophylla*), *Salvia lycioides* (= *Salvia ramosissima*), *Salvia regla*, *Salvia roemeriana*, and *Sophora secundiflora*. Stands occur on foothills, mountain slopes and canyons in drier habitats below the encinal and pine woodlands. Sites are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in higher-elevation transition areas with more mesic woodlands. In the Trans-Pecos of Texas, disjunct *Quercus gambelii* may occur as a significant component of this shrubland. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Bouteloua curtipendula*, *Bouteloua hirsuta*, and *Muhlenbergia emersleyi*.

***Cercocarpus montanus / Muhlenbergia setifoli*a Shrubland**

Alderleaf Mountain-mahogany / Curlyleaf Muhly Shrubland (Table C99)

Identifier: CEPP006879

Table C99. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Cercocarpus montanus / Muhlenbergia setifolia* Shrubland

Distribution

This common association is scattered through the Basin and Range area, and occurs near Guadalupe Peak on the foothills of the Eastern Escarpment of Guadalupe Mountains NP.

Environmental Description

This association can be found in the elevation range of 5,938 to 6,677 ft (1,810 to 1,950 m), on moderate colluvial slopes with northern aspects. Sites are substantially rocky or bare in the herbaceous interspaces, averaging 66% cover of rock, gravel, or soil exposure. Geologic substrates are the Carlsbad and Goat Seep Limestones, with the southernmost site occurring on older alluvial deposits.

Soils are mapped primarily as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) with one site occurring soils mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland varies from 11% to 40% shrub cover, dominated by *Cercocarpus montanus* var. *paucidentatus* (Table C100) alongside *Dasylirion leiophyllum*, and *Nolina texana*. Generally, *Agave parryi* ssp. *neomexicana* is also present. Grasses in the understory are very abundant, averaging 26% cover, and dominated by *Muhlenbergia setifolia*.

Consistently *Eragrostis intermedia* is present, usually with lesser amounts of *Bouteloua curtipendula* and *Achnatherum lobatum*. Forbs are a minor component of this association, the 26 variable species total an average cover of 2%. *Linum vernale* and *Allium kunthii* are the two most common, followed by *Eriogonum hieraciifolium*. Tree cover (represented by *Pinus edulis* and *Juniperus monosperma*) rarely exceeds 1% and is often absent.

Table C100. Most Abundant Species

Stratum	Species
Shrub	*Cercocarpus montanus var. paucidentatus*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ016, 07PA005, 07PA007, 07PA013, 07YC016.
Local Description Authors: H. Varani

***Juniperus pinchotii / Quercus (pungens, × pauciloba) / Muhlenbergia setifolia* Woodland**
Pinchot's Juniper / Wavyleaf Oak / Curlyleaf Muhly Woodland (Table C101)

Identifier: CEPP006893

Table C101. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Juniperus pinchotii / Quercus (pungens, × pauciloba) / Muhlenbergia setifolia* Woodland

Distribution
This common association occurs on in the Eastern Alluvial Uplands area, in the foothills of the Eastern Escarpment of Guadalupe Mountains NP.

Environmental Description
This association occurs in areas with little to no slope, within the elevations of 5,019 to 5,601 ft (1,530 to 1,707 m). Sites are gravely, and feature some rock and litter among the patchy herbaceous vegetation. Geologic substrates are mostly older alluvial deposits, but one atypical site has substrates of the Bell Canyon Formation.

Soils are mapped primarily as Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), but soil units also include McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
Mature trees do not occur in the canopy of this diverse woodland association, though *Juniperus pinchotii* is common as saplings and poles in the shrub canopy (Table C102). Shrub canopies range from 20% to 50% cover,

and are dominated by *Quercus pungens* with *Quercus* × *pauciloba* often codominant. Other common shrubs include *Rhus trilobata*, *Nolina texana*, *Mimosa aculeaticarpa* var. *biuncifera*, and *Yucca elata*. Fifteen subshrubs and cacti can cover as much as 20% and frequently include *Opuntia phaeacantha*, *Gutierrezia sarothrae*, and *Thymophylla setifolia* var. *radiata*. The understory is grass dominated and also ranges from 20% to 50% cover, including 21 species. *Muhlenbergia setifolia* is the dominant, but commonly *Bouteloua hirsuta*, *Eragrostis intermedia*, *Bouteloua curtipendula*, *Tridens muticus*, and *Erioneuron pilosum* are components. Though not as consistently present, *Aristida purpurea* can be well represented. The 49 recorded forb species occasionally total more than 5% cover, with the majority of species not individually breaking 1%. *Viguiera dentata*, *Chamaesyce chaetocalyx*, and *Polygala barbeyana* are the most commonly occurring; *Thelesperma longipes* (exceeding 1% where it occurs), *Chamaesaracha texensis*, *Polygala alba*, *Dalea jamesii*, and *Evolvulus sericeus* also appear repeatedly.

Table C102. Most Abundant Species

Stratum	Species
Tree Subcanopy	*Juniperus pinchotii*
Shrub Canopy	*Quercus pungens, Quercus* × *pauciloba*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC201, 07CJ042, 08GM011, 08GM014, 08GM023, 10TN007.
Local Description Authors: H. Varani

***Quercus* × *pauciloba / Achnatherum lobatum* Shrubland**
Wavyleaf Oak / Little Awn Needlegrass Shrubland (Table C103)

Identifier: CEPP007153

Table C103. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Quercus* × *pauciloba / Achnatherum lobatum* Shrubland

Distribution
This infrequent association can be found in the Mountain High Country area in Guadalupe Mountains NP, in and near West Dog Canyon.

Environmental Description
This association is known to occur within the elevations of 6,549 to 7,352 (2,241 to 2,078 m) on steep north and east facing slopes. Sites are rocky and gravelly in vegetated interspaces. Geologic substrates are the Carlsbad Limestone, with one site on the sandstone member of this formation.

Soils are mapped in the two following units: Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) and Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland is characterized by luxuriant shrub canopies dominated by *Quercus* × *pauciloba* (Table C104) and including *Nolina texana*,*Ceanothus greggii*, and *Mahonia haematocarpa* as components. Commonly, *Cercocarpus montanus* var. *paucidentatus*, *Rhus trilobata*, *Dasylirion leiophyllum*, and the subshrub *Gutierrezia sarothrae* are present, while at one site, *Lorandersonia spathulata* is abundant. The grassy understory varies widely in cover, from 10% to 60%. The diverse herbaceous species are dominated by *Achnatherum lobatum*, with *Muhlenbergia pauciflora* and *Eragrostis intermedia* present to well represented. Forbs may be absent or cover as much as 15%, but vary in composition. Of the 28 potential species, most are scattered with *Viguiera dentata*, *Paronychia jamesii*, *Eriogonum hieraciifolium*, and *Houstonia acerosa* var. *polypremoides* as common. Scattered trees, *Quercus grisea*, or *Pinus edulis* may be present with low cover.

Table C104. Most Abundant Species

Stratum	Species
Shrub	*Quercus* × *pauciloba*
Herb	*Achnatherum lobatum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC219, 07CJ002, 07CJ008.
Local Description Authors: H. Varani

***Quercus (pungens, × pauciloba) / Muhlenbergia emersleyi* Shrubland**
Pungent Oak - Wavyleaf Oak / Bullgrass Shrubland (Table C105)

Identifier: CEPP007148

Table C105. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Quercus (pungens, × pauciloba / Muhlenbergia emersleyi* Shrubland

Distribution
This very common association occurs in McKittrick Canyon, in the Mountain High Country, and the Eastern Escarpment areas of Guadalupe Mountains NP.

Environmental Description

This association is found in the elevation range of 5,010 to 6,480 ft (1,527 to 1,975 m), generally on very steep, colluvial slopes. Sites are southerly (one site was atypically located on a very gentle, northerly site) with rock and litter in between the patches of grass. Geologic substrates are predominantly of the Capitan Limestone (and massive layers member), but also include younger and older alluvial deposits, and the Hegler limestone member of the Bell Canyon Formation.

Soils are mapped mainly as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), but other units include: Victorio-Lozen Rock outcrop complex soils, 40 to 95% slopes (VLH) (loamy-skeletal or cleyey-skeletal, mixed, superactive, mesic Lithic Argiustolls of forestlands), Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) and Lazarus loam, 2 to 9% slopes (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This diverse shrubland of 33 shrub species features very abundant to luxuriant shrub canopies dominated by *Quercus pungens* with *Quercus* × *pauciloba* often present to codominant (Table C106). *Dasylirion leiophyllum*, *Viguiera stenoloba*, *Rhus virens* and *Rhus virens* var. *choriophylla* frequently contribute substantially to shrub canopies. The subshrub component averages less than 5% cover, but includes 19 variable species, most often the succulents *Opuntia phaeacantha* and *Agave lechuguilla*. The grassy understory ranges widely in cover, from 3% to 60% but is always dominated by *Muhlenbergia emersleyi*, often including populations of *Bouteloua curtipendula*, and/or *Eragrostis intermedia*. Forbs are a minor component of the herbaceous layer, not exceeding 5%. The 43 observed species are generally scattered; the most common are *Astrolepis cochisensis*, *Artemisia ludoviciana*, *Erigeron flagellaris*, and *Viguiera dentata*. Trees are generally absent in this association type, rarely represented by a combination of scattered *Quercus grisea*, *Arbutus xalapensis*, *Juniperus deppeana*, and *Juniperus pinchotii*.

Table C106. Most Abundant Species

Stratum	Species
Shrub	*Quercus pungens or Quercus* × *pauciloba*
Herb	*Muhlenbergia emersleyi*

Other Noteworthy Species

Verbascum thapsus is a biennial introduced forb, recorded once in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC182, 06YC227, 06YC228, 06YC229, 06YC230, 07CJ006, 08CJ024, 08GM002, 08GM021, 08GM022, 08SS019, 08SS112.
Local Description Authors: H. Varani

***Quercus (pungens, × pauciloba) / Muhlenbergia pauciflora* Shrubland**
Pungent Oak - Wavyleaf Oak / New Mexico Muhly Shrubland (Table C107)

Identifier: CEPP007149

Table C107. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Quercus (pungens, × pauciloba) / Muhlenbergia pauciflora* Shrubland

Distribution
This very common association occurs throughout the Mountain High Country area of Guadalupe Mountains NP. Examples of it can also be found in the Eastern Escarpment and Pine Spring Canyon areas as well.

Environmental Description
This association is found in the elevations ranging from 5,600 to 8,233 ft (1,706 to 2,509 m). Sites occur on gentle to very steep slopes with a variety of aspects, and are generally rocky with patches of litter among the grass understories. Geologic substrates are primarily of the Carlsbad Limestone (and the sandstone member of Carlsbad Limestone), but also include the Capitan Limestone and both the Pinery limestone and Hegler limestone members of the Bell Canyon Formation.

The majority of soils are mapped as Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) and 40 to 95% slopes (VLH) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls) but other soil units include Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), and Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls). One site is atypically mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description
The 50% average shrub cover of this shrubland association is dominated by *Quercus* × *pauciloba* with *Quercus pungens* often present to well represented (Table C108). A variety of the 32 additional shrub species occur, most commonly *Cercocarpus montanus* or *Cercocarpus montanus* var. *paucidentatus*, *Ceanothus greggii*, and *Nolina texana*. Not as frequently seen, *Garrya ovata* ssp. *goldmanii*, and *Rosa stellata* can be abundant. Typically, a variety of trees are scattered in this association, rarely exceeding 10% cover, but there may be denser tree patches included in some areas. Most often they include *Pinus ponderosa*, *Juniperus deppeana*, *Pinus edulis*, and *Pseudotsuga menziesii*. Beneath the shrubs, subshrubs are a minor component of this shrubland association, averaging only 3% cover and frequently absent. Where they occur, *Quercus* × *pauciloba* is likely to be a substantial component of this shorter layer as well, potentially appearing alongside a short statured *Robinia neomexicana*, the succulent *Agave parryi* ssp. *neomexicana*, and/or the subshrub *Gymnosperma glutinosum*. These subshrubs occur in an understory that is grass dominated though ranges from less than 5% to as much as 60% cover. The herbaceous layer is dominated by *Muhlenbergia pauciflora*. The most common of the 28 observed species are *Eragrostis intermedia*, *Muhlenbergia dubia*, *Achnatherum lobatum*, and *Bouteloua curtipendula*; occasionally *Andropogon gerardii* or *Muhlenbergia emersleyi* is abundant. Forb cover is low or occasionally absent with an average of only 1.5%. The 62 species are variable, most often including *Tragia ramosa*, *Artemisia ludoviciana*, and *Paronychia jamesii*.

Table C108. Most Abundant Species

Stratum	Species
Shrub	*Quercus* × *pauciloba, Quercus pungens*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections, it is rare in this association.

Solidago wrightii var. *guadalupensis* is classified as a New Mexico rare plant. Generally found on limestone outcrops and substrates in Chaves and Eddy counties, New Mexico, and in Culberson County, Texas, it is infrequent and scarce in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06EM075, 06EM076, 06EM082, 06EM108, 06EM111, 06YC181, 06YC191, 06YC203, 06YC221, 07CJ014, 07CJ015, 07CJ034, 08CJ020, 08CJ029, 08CJ080, 10CJ011, 10CJ021, 10CJ040, 10CJ041, 10CJ049, 10CJ057, 10CJ062, 10CJ070, 10EL002, 10EL003, 10EL008, 10EL027, 10EL029, 10EL032, 10EL033, 10EL037, 10EL045, 10EL046, 10EL052, 10EL061, 10EL063.
Local Description Authors: H. Varani

***Quercus pungens / Bouteloua gracilis* Shrubland**

Pungent Oak / Blue Grama Shrubland (Table C109)

Identifier: CEPP007150

Table C109. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	Eastern Madrean Chaparral Group [G280]
Association	*Quercus pungens / Bouteloua gracilis* Shrubland

Distribution

This infrequent association is known to occur in the Eastern Alluvial Upland area, near Pine Springs, in Guadalupe Mountains NP.

Environmental Description

This association is recorded at the elevations of 5,594 and 5,638 ft (1,706 and 1,719 m) on gentle colluvial slopes. Ground surface covers at sites may be substantially gravel or bare between bunchgrasses. Geologic substrates are older alluvial deposits.

Soils are mapped as Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG); these are very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description
This open shrubland association is dominated by patches of *Quercus pungens* (Table C110), likely including *Dasylirion leiophyllum*, *Cercocarpus montanus*, *Nolina texana* and young individuals of *Juniperus pinchotii*. The herbaceous patches are dominated by the bunchgrass *Bouteloua gracilis*, and may include *Hesperostipa neomexicana*. Forbs are represented by buckwheat (*Eriogonum* spp.). Paddle cacti may be present (*Opuntia* spp.). Mature canopy trees are not recorded.

Table C110. Most Abundant Species

Stratum	Species
Shrub	*Quercus pungens*
Herb	*Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN004, 10TN006.
Local Description Authors: H. Varani

***Quercus pungens / Muhlenbergia setifolia* Shrubland**
Pungent Oak / Curlyleaf Muhly Shrubland (Table C111)

Identifier: CEPP007152

Table C111. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Grassland & Shrubland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Western North American Interior Chaparral (2.B.2.Nd)
Macrogroup	Warm Interior Chaparral (M091)
Group	
Association	*Quercus pungens / Muhlenbergia setifolia* Shrubland

Distribution
This association occurs along Frijole Trail area of Guadalupe Mountains NP.

Environmental Description
This association was found at 5,812 ft (1,773 m) elevation on moderately steep slopes (15%) with a southeast aspect.

Sites is a broad grassland ridgetop with scattered oak and shrubs 2-3 hectares in size. There is a boulder field to the east and scattered fire-killed junipers are present. Sites are gravelly (20% cover) with high herbaceous cover (7)%). Geologic substrates are primarily older alluvial deposits.

The soils are mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrub association is dominated by *Quercus* × *pauciloba* (or *Quercus pungens*) typically present to well represented (Table C112). Additional shrub species such as *Cercocarpus montanus* var. *paucidentatus*, *Dasylirion leiophyllum*, and *Nolina texana*. The herbaceous layer is dominated by *Muhlenbergia setifolia*. The most common other grass species are *Aristida purpurea* and *Eragrostis intermedia*. Forb cover is low < 1% and includes *Dalea* spp., *Eriogonum* spp., and *Zinnia acerosai*.

Table C112. Most Abundant Species

Stratum	Species
Shrub	*Quercus* × *pauciloba*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ025.
Local Description Authors: K.A. Schulz

G531 Arid West Interior Freshwater Marsh Group

Schoenoplectus americanus Western Marsh

Chairmaker's Bulrush Western Marsh (Table C113)

Identifier: CEGL001841

Table C113. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub and Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
Division	Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (2.C.4.Nb)
Macrogroup	Arid West Interior Freshwater Marsh (M888)
Group	Arid West Interior Freshwater Marsh Group [G531]
Association	*Schoenoplectus americanus* Western Marsh

Distribution

This uncommon association is known from the Eastern Alluvial Uplands area of Guadalupe Mountains NP, at Manzanita Spring.

Environmental Description

This association occurs at 5,338 ft (1,627 m) on the banks of a large, permanent, and historically manipulated (dredged) pond. Geologic substrates at this site are older alluvial deposits.

Soil at the site is mapped as Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG), made up of very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description
Four herbaceous species are recorded at this site, including *Eleocharis rostellata*, *Festuca pratensis*, *Panicum virgatum*, and *Schoenoplectus americanus* (Table C114).

Table C114. Most Abundant Species

Stratum	Species
Herb	*Schoenoplectus americanus*

Other Noteworthy Species
Festuca pratensis is an introduced perennial grass found at this site.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: CEGL001841.
Local Description Authors: H. Varani

G538 North American Desert Alkaline - Saline Marsh & Playa

Sporobolus airoides Monotype Wet Meadow
Alkali Sacaton Monotype Wet Meadow (Table C115)

Identifier: CEGL001688

Table C115. US National Vegetation Classification

Level	Unit
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub and Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	North American Western Interior Brackish Marsh, Playa & Shrubland (2.C.5.Nd)
Macrogroup	Warm & Cool Desert Alkali - Saline Marsh, Playa & Shrubland (M082)
Group	North American Desert Alkaline - Saline Marsh & Playa [G538]
Association	*Sporobolus airoides* Monotype Wet Meadow

Distribution
This infrequent association is found near the westernmost park boundary (south of Crow Flats) in the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association occurs near playas at 3,643 and 3,645 ft (1110 and 1112 m). Sites are not sloped and feature an average of 74% exposed soil without gravel or rock in the vegetated interspaces. Geologic substrates are of alluvial deposits.

Soils are mapped as and Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description
Vegetation is sparse in this herbaceous association type, not exceeding 20% cover. The dominant species is *Sporobolus airoides* (Table C116), occurring with scattered and inconspicuous Phacelias (*Phacelia* spp.). One site was somewhat woody in character, featuring *Atriplex canescens* and including *Suaeda nigra*. *Opuntia imbricata* is found nearby.

Table C116. Most Abundant Species

Stratum	Species
Herb	*Sporobolus airoides*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN017, 10TN018.
Local Description Authors: H. Varani

G288 Chihuahuan Creosotebush - Mixed Desert Scrub Group

***Acacia neovernicosa / Bouteloua eriopoda* Shrubland**
Viscid Acacia / Black Grama Shrubland (Table C117)

Identifier: CEPP006869

Table C117. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Acacia neovernicosa / Bouteloua eriopoda* Shrubland

Distribution
This uncommon association is known to occur on the eastern foothills of El Capitan peak, in Guadalupe Mountains NP.

Environmental Description
This association occurs within the elevation range of 5,249 to 5,558 ft (1,600 to 1,694 m) on moderate slopes with variable aspects. Sites are gravelly with scattered rock, and may feature patches of litter in the vegetated interspaces. Geologic substrates are younger alluvial deposits and the Brushy Canyon Formation.

Soils are mapped as Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG), which are loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents (USDA NRCS and USDI NPS 2010).

Vegetation Description

The shrub canopy of this shrubland association is composed of 17 species and varies widely from 15% to 80% cover. *Acacia neovernicosa* is the dominant (Table C118), occurring alongside *Krascheninnikovia lanata*, *Yucca elata*, and *Cylindropuntia imbricata*. Subshrubs are well represented by *Gutierrezia sarothrae*, *Krameria grayi* and nine other less abundant and variable species. The understory features abundant to luxuriant grass cover composed of the dominant *Bouteloua eriopoda*, along with *Bouteloua curtipendula*, *Bouteloua gracilis*, and *Muhlenbergia setifolia*. Forbs are a minor component; of the 18 recorded associates, *Thymophylla pentachaeta* is the most common. Trees do not occur in this association.

Table C118. Most Abundant Species

Stratum	Species
Shrub	*Acacia neovernicosa*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ037, 07YC039, 07YC044.
Local Description Authors: H. Varani

***Flourensia cernua / Muhlenbergia porteri* Shrubland**

Tarbush / Bush Muhly Shrubland (Table C119)

Identifier: CEPP007428

Table C119. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Flourensia cernua / Muhlenbergia porteri* Shrubland

Distribution

This uncommon association is known to occur in El Centro Draw, in the Bajadas area of Guadalupe Mountains NP.

Environmental Description

This association is found at 4,380 ft (1,3335 m) in an area with very little slope. The site has no rock or gravel, and negligible amounts of exposed soil or litter cover among the dense herbaceous cover. The geologic substrates are younger alluvial deposits.

The soil at this site is mapped as Chispa-Tenneco complex, 2 to 9% slope (CAD); these are fine-loamy, mixed, superactive thermic Ustic Haplocalcids or fine-loamy, mixed, superactive thermic Ustic Haplocambids, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This low diversity shrubland association features 50% shrub cover dominated by *Flourensia cernua* (Table C120) with very abundant cover of *Prosopis glandulosa*. Of all the remaining shrubs as the site, *Yucca elata* is also well represented, *Atriplex canescens*, and *Larrea tridentata* are poorly represented, and *Rhus microphylla* is present. No subshrubs occur. The luxuriant herbaceous understory approaches 100% cover, and is divided similarly between the grasses and forbs. The three grass species are dominated here by the very abundant *Setaria leucopila* and the abundant *Muhlenbergia porteri*; *Sporobolus airoides* is poorly represented. The forb component includes eight species, but cover is almost entirely composed of *Parthenium confertum* var. *lyratum*. Trees do not occur in this association.

Table C120. Most Abundant Species

Stratum	Species
Shrub	*Flourensia cernua*
Herb	*Muhlenbergia porteri*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ031.
Local Description Authors: H. Varani

***Larrea tridentata - Flourensia cernua* Sparse Shrubland**
Creosotebush - Tarbush Sparse Shrubland (Table C121)

Identifier: CEPP006895

Table C121. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata - Flourensia cernua* Sparse Shrubland

Distribution
This uncommon association occurs near the Patterson Hills in the Bajadas area of Guadalupe Mountains NP.

Environmental Description
This site occurs at 4,469 ft (1,362 m) in an upland valley bottom. The site has almost no slope, and is clearly disturbed by a burrowing animal, most likely a badger (*Taxidea taxus*) resulting in more than 75% ground cover of gravel or exposed soil. The geologic substrates are younger alluvial deposits,

The soil is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD), which are loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association features a 40% shrub canopy codominated by *Flourensia cernua* and *Larrea tridentata* (Table C122); *Yucca elata* is poorly represented, (*Cylindropuntia leptocaulis*, and *Yucca torreyi* are also present). Subshrubs are well represented consisting mainly of *Parthenium incanum*, and *Krameria grayi* (*Gutierrezia sarothrae*, *Menodora scabra*, *Opuntia macrocentra*, *Opuntia phaeacantha*, *Thymophylla acerosa*, and *Echinocereus dasyacanthus* are scattered). The understory consists mainly of forbs, these covering 12% and codominated by *Chamaesyce serpyllifolia* and *Thymophylla pentachaeta* while *Bahia absinthifolia* is poorly represented (*Chamaesyce serrula* and *Acourtia nana* are also present). Grasses are scattered and include *Aristida purpurea* var. *wrightii*, *Munroa squarrosa*, and *Muhlenbergia porteri*. Trees do not occur at this site.

Table C122. Most Abundant Species

Stratum	Species
Shrub	*Flourensia cernua, Larrea tridentata*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC245.
Local Description Authors: H. Varani

***Larrea tridentata - Krameria grayi* Shrubland**

Creosotebush - White Ratany Shrubland (Table C123)

Identifier: CEPP006896

Table C123. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata - Krameria grayi* Shrubland

Distribution

This infrequent association is known to exist near Butterfield Trail and PX Well in Guadalupe Mountains NP.

Environmental Description

The association occurs at elevations of 3,848 and 4,386 ft (1,173 and 1,337 m) in a flat ridgetop to very gently sloped landscape. Both sites feature high gravel cover (40-55%) and moderate exposed soil (20-30% cover) in the vegetated interspaces, with a small amount (2%) cryptogrammic crust cover. Geologic substrates are older and younger alluvial deposit. Soils are mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal (or fine-loamy), mixed, superactive, thermic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association features a shrub canopy ranging from 15% cover to 30% cover mostly composed of *Larrea tridentata* (Table C124) and including less than 3% cover of *Prosopis glandulosa* and sometimes *Viguiera stenoloba*. The remaining nine species occur at one site or the other, and are scattered. Subshrubs are an important contributor, ranging from 15% to 20% cover and including abundant cover of *Krameria grayi* and scattered individuals of *Echinocereus dasyacanthus* among the seven other variable species recorded. The herbaceous understory varies, grasses reach 25% cover at one site, but only 5% cover at the other. Among the 11 species *Muhlenbergia porteri*, *Bouteloua eriopoda*, and *Sporobolus contractus* are common between site and *Munroa squarrosa* is abundant at one site. Forbs may reach a total cover of 5% including *Thymophylla pentachaeta* commonly.

Table C124. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Subshrub	*Krameria grayi*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC258, 07CJ049.
Local Description Authors: H. Varani

***Larrea tridentata - Parthenium incanum* Shrubland**

Creosotebush - Mariola Shrubland (Table C125)

Identifier: CEGL001274

Table C125. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata - Parthenium incanum* Shrubland

Distribution

This infrequent association is found in the Bajadas area of Guadalupe National Park, extending from the northernmost park boundary to the Patterson Hills.

Environmental Description

This association occurs from 3,940 to 4,347 ft (1,201 to 1,415 m) on very gentle slopes, with variable aspects. Sites are gravely, with substantial rock or soil exposure. Geologic substrates are younger and older alluvial deposits.

Soils are mapped primarily as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series) but also include Chispa-Tenneco complex, 2 to 9% slope (CAD) (fine-loamy, mixed, superactive thermic Ustic Haplocalcids or fine-loamy, mixed, superactive thermic Ustic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland is characterized by very abundant shrub cover dominated by *Larrea tridentata* (Table C126) and including nine other poorly represented shrubs such as *Prosopis glandulosa* and *Yucca torreyi*. Subshrubs can also be abundant, and most commonly include *Parthenium incanum* exceeding 5% cover and scattered *Opuntia phaeacantha*. The herbaceous layer does not exceed 20% cover, and mostly consists of forbs. Of the 11 observed species, *Thymophylla pentachaeta* dominates, occasionally codominated by *Chamaesyce serpyllifolia*; *Bahia absinthifolia* is included. Of the 10 recorded grass species, most are scattered and only *Muhlenbergia porteri* appears consistently. No trees occur in this association.

Table C126. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Subshrub	*Parthenium incanum*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC242, 06YC256, 07CJ032, 07CJ050.
Local Description Authors: H. Varani

***Larrea tridentata / Bouteloua eriopoda* Shrubland**

Creosotebush / Black Grama Shrubland (Table C127)

Identifier: CEGL001265

Table C127. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata / Bouteloua eriopoda* Shrubland

Distribution

This common association is scattered though the Bajadas area and can be found in the Western Escarpment area of Guadalupe Mountains NP; its extent nearly reaches both the northernmost and the southernmost park boundaries.

Environmental Description

This association is known to occur on gentle to moderate slopes within the elevation range of 3,839 to 4,882 ft (1,170 to 1,488 m). Sites tend to have south or west aspects and substantial gravel cover, sometimes also with exposed soil or rock in the vegetated interspaces. Soils feature a small amount of cryptogrammic crust cover, (less than 5% cover). Geologic substrates are younger and older alluvial deposits, with one site situated on Victorio Peak gray member of the Bone Springs Limestone.

Soils are mapped primarily as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal (or fine-loamy), mixed, superactive, thermic Ustic Haplocalcids. One site is classified as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) made up of loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association is characterized by an open shrub canopy that rarely exceeds 25% cover, and is dominated by *Larrea tridentata* (Table C128). Commonly *Prosopis glandulosa*, *Viguiera stenoloba*, and *Opuntia engelmannii* are among the 15 other poorly represented and scattered shrubs. Subshrubs can reach 15% cover and vary among 22 species; *Parthenium incanum*, *Opuntia phaeacantha*, and *Thymophylla acerosa* are commonly included and occasionally well represented, while *Krameria grayi*, and *Echinocereus dasyacanthus* are commonly included but generally poorly represented or scattered. The understory of abundant to very abundant grass cover is most frequently dominated by *Bouteloua eriopoda*, commonly including *Muhlenbergia porteri*. Occasionally *Bouteloua curtipendula*, *Muhlenbergia tenuifolia* or *Eragrostis lehmanniana* can be dominant, but *Bouteloua eriopoda* is always present. Forbs are variable, and generally do not exceed 10% total cover (with an unusual site reaching 30% total cover). Among the most common, *Thymophylla pentachaeta* can be very abundant, and *Bahia absinthifolia* is generally poorly represented; occurring less frequently, *Chamaesyce serrula* may be well represented. Trees do not occur in this association.

Table C128. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species

Eragrostis lehmanniana is an introduced perennial grass that is very abundant at one site in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC235, 06YC236, 07CJ046, 07YC051, 10TN028.
Local Description Authors: H. Varani

***Larrea tridentata / Bouteloua gracilis* Shrubland**

Creosotebush / Blue Grama Shrubland (Table C129)

Identifier: CEGL001266

Table C129. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata / Bouteloua gracilis* Shrubland

Distribution

This uncommon association is present in the Bajadas area of Guadalupe Mountains NP, near the mouth of Bone Canyon.

Environmental Description
This site occurs at an elevation of 4,820 ft (1,469 m), on a gentle, westerly slope. The site is predominantly covered with gravel in the vegetated interspaces. Geologic substrates are younger alluvial deposits.

Soil at the site is classified as Chilicotal-Chispa complex, 3 to 13% slopes (CCD), which are loamy-skeletal (or fine-loamy), mixed, superactive, thermic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland features 30% shrub cover, primarily composed of *Larrea tridentata* (Table C130) and including *Prosopis glandulosa*. Other minor components of the shrub canopy are *Viguiera stenoloba*, *Cylindropuntia imbricata*, *Yucca elata*, and *Opuntia engelmannii*. The 15% cover of the subshrub canopy is dominated by *Parthenium incanum*. Of the remaining 11 species, nine are cacti or succulents (with examples including *Echinocereus triglochidiatus*, *Echinocereus horizonthalonius*, *Opuntia phaeacantha*, and *Escobaria vivipara*). The grassy understory features 30% grass cover and includes eight graminoid species dominated clearly by *Bouteloua gracilis* (and including *Bouteloua curtipendula*, *Bouteloua eriopoda*, and *Muhlenbergia porteri*). Forbs are well represented and consist of eight species, predominantly *Thymophylla pentachaeta*, and including *Bahia absinthifolia*, *Chamaesyce serpyllifolia*, and *Chamaesyce serrula*. Trees do not occur at this site.

Table C130. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Herb	*Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC238.
Local Description Authors: H. Varani

***Larrea tridentata / Muhlenbergia porteri* Shrubland**
Creosotebush / Bush Muhly Shrubland (Table C131)

Identifier: CEGL001272

Table C131. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata / Muhlenbergia porteri* Shrubland

Distribution
This common association is located on the slight slopes extending from the Western Escarpment and Patterson Hills in the Bajadas Areas of Guadalupe Mountains NP. One site occurs in the Western Escarpment area, near Bone Spring.

Environmental Description

This association occurs in the elevation range of 3,727 to 5,591 ft (1,136 to 1,704 m). Sites tend to be very gently sloped and vary in aspect (with the atypical Bone Spring site on a steep southerly back-slope). In the vegetated interspaces ground surfaces are generally bare, sometimes concealed by litter or with exposed rock and gravel. Geologic substrates are younger alluvial deposits, with the Bone Spring site occurring on the Brushy Canyon Formation.

Soils are classified in the four following units: Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents), Chispa-Tenneco complex, 2 to 9% slope (CAD) (fine-loamy, mixed, superactive thermic Ustic Haplocalcids or fine-loamy, mixed, superactive thermic Ustic Haplocambids respective to series), Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids, respective to series) and Monahans-Pajarito complex, 0 to 5% slopes (MPB) (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland is characterized by 15% to 50% shrub cover dominated by *Larrea tridentata* (Table C132). Most frequent of the 13 other poorly represented shrubs are *Cylindropuntia imbricata*, *Flourensia cernua*, and *Atriplex canescens*. At sites where subshrubs occur (rarely exceeding 5%) they likely include *Parthenium incanum* and scattered cacti (*Opuntia phaeacantha*, *Echinocereus triglochidiatus*). Herbaceous layers average more than 40% cover and can be either grass or forb dominated. Among the dozen grass species, *Setaria leucopila* is codominant with *Muhlenbergia porteri*, and commonly *Bouteloua gracilis* and *Bouteloua eriopoda* can be well-represented. The 17 recorded forb species are more variable in composition, *Laennecia coulteri* and *Thymophylla pentachaeta* can be very abundant, while the more common *Aphanostephus ramosissimus* and *Bahia absinthifolia* can be well represented. Trees do not occur in this association.

Table C132. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Herb	*Muhlenbergia porteri*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC234, 07CJ033, 07CJ053, 07YC022, 07YC053.
Local Description Authors: H. Varani

Larrea tridentata / Sparse Understory Shrubland

Creosotebush / Sparse Understory Shrubland (Table C133)

Identifier: CEGL001276

Table C133. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Larrea tridentata* / Sparse Understory Shrubland

Distribution

This infrequent association is located on the slopes extending from the Western Escarpment and Patterson Hills, in the Bajadas area of Guadalupe Mountains NP.

Environmental Description

This association is known to occur in the elevations ranging from 3,783 to 4,731 ft (1,153 to 1,442 m) on very gentle, westerly slopes. Sparse herbaceous understories at sites generally expose gravel (averaging 26% cover) and soil (averaging 21% cover), or cryptograms (ranging widely, from 0 to 70% cover). Geologic substrates are younger alluvial deposits.

Soils are mapped primarily as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series) with site mapped as Chispa-Tenneco complex, 2 to 9% slope (CAD) (fine-loamy, mixed, superactive thermic Ustic Haplocalcids or fine-loamy, mixed, superactive thermic Ustic Haplocambids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland features abundant to luxuriant shrub cover, generally dominated by *Larrea tridentata* (Table C134) and featuring *Prosopis glandulosa* (sometimes the two codominate) and a variety of eight other scattered shrubs. Of the ten scattered subshrubs and cacti species (a grouping that rarely exceeding 1% cover), only *Parthenium incanum* appears consistently. The combination of grasses and forbs rarely exceeds 10% cover, with forbs being more prevalent than grasses. The eight observed forb species regularly include *Thymophylla pentachaeta* and *Bahia absinthifolia*. The three grass species, *Muhlenbergia porteri*, *Setaria leucopila*, and *Sporobolus cryptandrus*, do not individually exceed 1% cover. No trees occur in this association.

Table C134. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC239, 07CJ030, 07CJ051, 07CJ052.
Local Description Authors: H. Varani

***Mortonia scabrella - Parthenium incanum* Shrubland**
Rio Grande Saddlebush - Mariola Shrubland (Table C135)

Identifier: CEPP006899

Table C135. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Mortonia scabrella - Parthenium incanum* Shrubland

Distribution
This infrequent association is known to occur in the Western Escarpment area near Bone Spring and southeast of El Capitan Peak, in Guadalupe Mountains NP.

Environmental Description
This association has been recorded at the elevations of 5,591 and 5,610 ft (1,705 and 1,711 m) on a gentle and a steep slope of variable aspects. Sites are rocky with some gravel (20% cover), and some litter patches (15% average cover). Minute amounts of cryptograms occur. Geologic substrates are of the Brushy Canyon Formation.

Soils are classified as Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) which are loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association features very abundant shrub canopies consisting of 20 shrub species. They are codominated by *Cercocarpus montanus* var. *paucidentatus* and *Mortonia scabrella* (Table C136); *Dasylirion leiophyllum*, *Viguiera stenoloba*, and *Krascheninnikovia lanata* are also common. Ten species of subshrubs and cacti are, as a group, well represented; most commonly by *Thymophylla acerosa*, *Dalea formosa*, and *Parthenium incanum*. Grass cover at both sites is 20% and includes *Bouteloua curtipendula*, *Lycurus setosus*, and *Tridens muticus*. The remaining nine grass species vary and occur at one site or the other, *Eragrostis intermedia* and *Muhlenbergia pauciflora* are well represented where they occur. *Croton dioicus*, *Melampodium leucanthum*, *Eriogonum hieraciifolium*, and *Tetraneuris scaposa* are common among the 22 forb species, which as a group, do not exceed 5% cover. Trees do not occur in this shrubland.

Table C136. Most Abundant Species

Stratum	Species
Shrub	*Mortonia scabrella*
Herb	*Parthenium incanum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC233, 07YC043.
Local Description Authors: H. Varani

Viguiera stenoloba / Parthenium incanum Shrubland

Skeletonleaf Goldeneye / Mariola Shrubland (Table C137)

Identifier: CEPP007514

Table C137. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Creosotebush - Mixed Desert Scrub Group [G288]
Association	*Viguiera stenoloba / Parthenium incanum* Shrubland

Distribution

This infrequent association is known from the Western Escarpment area (west of Cutoff Ridge), Eastern Escarpment area (near Upper Pine Spring Canyon) and Bajadas area (southwest of El Capitan Peak) of Guadalupe Mountains NP.

Environmental Description

This association has been recorded at elevations from 4,455 to 5,865 ft (1,358 to 1,788 m) on moderate to very steep slopes with variable aspects. Ground surfaces average 60% rock and gravel cover, and may feature small amounts of exposed soil, cryptogram growth, or litter deposition as well. Geologic substrates vary and include the Capitan Limestone and Cherry Canyon Formation, older alluvial deposits, and the Victorio Peak gray member of the Bone Springs Limestone.

Soils are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) (loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids), Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series) and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association features abundant to very abundant shrub dominated by *Viguiera stenoloba* (Table C138) ranging from 16 to 40% cover with an abundant dwarf-shrub layer dominated by *Parthenium incanum*. Associated shrub species, *Dasylirion leiophyllum*, *Mortonia scabrella*, and *Ephedra aspera* are the most common of the 15 other shrubs present to poorly represented. Subshrubs and cacti cover is also composed of 15 species and range from 8 to 15% cover; *Parthenium incanum* is sometimes codominant with *Gutierrezia sarothrae* with *Opuntia phaeacantha* always present. The diverse herbaceous layer varies in cover, grasses may be poorly represented to very abundant and include 19 species. *Bouteloua curtipendula*, *Bouteloua eriopoda*, and *Sporobolus cryptandrus* are most consistent and abundant. Occasionally forbs can exceed 5% cover, but generally have low cover. *Astrolepis cochisensis* and *Bahia absinthifolia* are generally present and *Thymophylla pentachaeta* can be abundant. Trees do not occur in this association.

Table C138. Most Abundant Species

Stratum	Species
Shrub	*Viguiera stenoloba*
Subshrub	*Parthenium incanum*

Other Noteworthy Species

Nama xylopodum is classified as a New Mexico rare plant that is scattered at one site in this association type. Generally preferring partly shaded limestone cliffs and outcrops in montane scrub to piñon-juniper-oak woodlands, it can be found in Eddy, Otero, and Chaves counties in New Mexico, and in El Paso and Culberson counties of Texas in the Franklin and Guadalupe mountains.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.

NHNM Plots: 06YC241, 06YC252, 07CJ057, 08SS023.

Local Description Authors: H. Varani

299 Chihuahuan Desert Lowland Basin Scrub

***Prosopis glandulosa / Sporobolus airoides* Shrubland**

Honey Mesquite / Alkali Sacaton Shrubland (Table C139)

Identifier: CEGL001385

Table C139. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Lowland Basin Scrub [G299]
Association	*Prosopis glandulosa / Sporobolus airoides* Shrubland

Distribution

This infrequent association can be found in quartzose dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description

This association occurs at 3,683 ft (1,127 m) on a flat site. The site is substantially bare (33% exposed soil cover) and features 15% cryptogrammic crust growth. Geologic substrates at the site are younger alluvial deposits.

Soil at the site is mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrubland association is composed of abundant cover of coppicing *Prosopis glandulosa* (Table C140) and including a small amount of *Atriplex canescens* in the canopy. *Ephedra torreyana* is present, and the subshrub *Gutierrezia sarothrae* grows nearby. The sparse herbaceous understory is dominated by *Sporobolus airoides*, well represented, while *Sporobolus nealleyi* is scarce. Neither forbs nor trees occur at this site.

Table C140. Most Abundant Species

Stratum	Species
Shrub	*Prosopis glandulosa*
Grass	*Sporobolus airoides*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN020.
Local Description Authors: H. Varani

***Larrea tridentata / Sporobolus airoides* Shrubland**
Creosotebush / Alkali Sacaton Shrubland (Table C141)

Identifier: CEGL001277

Table C141. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Lowland Basin Scrub [G299]
Association	*Larrea tridentata / Sporobolus airoides* Shrubland

Distribution
This infrequent association is known to occur in the quartzose dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association is recorded at an elevation of 3,665 ft (1,117 m). The site is not sloped, and ground surfaces in the vegetated interspaces are bare soil (31% cover), with a quarter of the site concealed by litter. No rock, gravel, or cryptograms are present at this site. Geologic substrates are younger eolian sand deposits.

Soils are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) made up of coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The entire species list for this site includes six species. *Larrea tridentata* dominates the open shrub canopy (Table C142), *Atriplex canescens* and *Prosopis glandulosa* occur in this shrubland association also, both poorly represented at this site. *Sporobolus airoides* covers just more than 20% of the understory, *Muhlenbergia porteri* is also present but does not exceed 0.5% cover, and Christmas cactus (*Opuntia leptocaulis*) is similarly scattered. No trees occur at this site.

Table C142. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Herb	*Sporobolus airoides*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN021.
Local Description Authors: H. Varani

287 Chihuahuan Desert Sand Scrub Group

***Atriplex canescens / Sporobolus (flexuosus, cryptandrus, contractus)* Shrubland**
Fourwing Saltbush / (Mesa, Sand, Spike) Dropseed Shrubland (Table C143)

Identifier: CEPP006874

Table C143. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Sand Scrub Group [G287]
Association	*Atriplex canescens / Sporobolus (flexuosus, cryptandrus, contractus)* Shrubland

Distribution
This infrequent association is known to occur in the quartzose dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association is found at 3,652 and 3,698 ft (1,113 and 1,127 m) on flat locations. Sites feature up to 50% bare soil, with 5% cryptogrammic crust cover and some litter in patches among the vegetation (litter cover averages 28%). Geologic substrates at the sites are younger alluvial deposits.

Soils are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) which are coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association features a shrub canopy that is open and patchy, reaching 15% cover composed of *Atriplex canescens (*Table C144), and *Prosopis glandulosa* may be present. The subshrub, *Gutierrezia sarothrae* may be present or absent. The herbaceous layer is abundant or very abundant and includes less than 5% cover each of *Sporobolus cryptandrus*, *Muhlenbergia porteri*, and *Bouteloua barbata*. The six other various grasses are poorly represented (and include *Sporobolus contractus*, *Bouteloua aristidoides*, *Sporobolus flexuosus*, *Dasyochloa pulchella*,

Scleropogon brevifolius, and *Aristida purpurea*). Eight scattered forbs vary from site to site, including *Bahia absinthifolia*, *Parthenium confertum* var. *lyratum*, *Psilostrophe tagetina*, and *Salsola tragus* for example. Where it occurs, *Aphanostephus ramosissimus* exceeds 1% cover. No trees occur in this association.

Table C144. Most Abundant Species

Stratum	Species
Shrub	*Atriplex canescens*
Herb	*Sporobolus cryptandrus, Sporobolus contractus, Sporobolus flexuosus*

Other Noteworthy Species

Salsola tragus is an introduced annual forb species observed scattered at one of the sites in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ068, 07YC081.
Local Description Authors: H. Varani

Larrea tridentata / Sporobolus flexuosus Shrubland

Creosotebush / Mesa Dropseed Shrubland (Table C145)

Identifier: CEPP006897

Table C145. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Sand Scrub Group [G287]
Association	*Larrea tridentata / Sporobolus flexuosus* Shrubland

Distribution

This infrequent association type occurs west of the gypseous dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description

This association occurs at the elevations of 3,698 and 3,714 ft (1,127 and 1,132 m) in the basin bottom. Sites are flat, and feature 40% cover of exposed soils and 20% cover of cryptogrammic crust in the vegetated interspaces. Substrates are formed from younger alluvial deposits.

Soils are Copia loamy fine sand, 2 to 7% slopes (COC) (mixed, thermic Typic Torripsamments), and Monahans-Pajarito complex, 0 to 5% slopes (MPB) (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrubland association features 20% cover of regularly dispersed shrubs, almost entirely composed of *Larrea tridentata* (Table C146). The four other shrubs recorded (*Atriplex canescens*, *Prosopis glandulosa*, and *Yucca elata*) are scattered at only one site or the other, and sites are without subshrubs. Grass cover can be reach 30%

in the shrub interspaces and includes *Sporobolus flexuosus*, *Sporobolus contractus*, and *Eragrostis lehmanniana*. However, *Bouteloua barbata*, *Muhlenbergia porteri*, or *Sporobolus cryptandrus* may dominate sites where they occur. Forbs vary from 1% total cover to 10% total cover, the dozen species generally dominated by the two most commonly observed: *Bahia absinthifolia*, and *Aphanostephus ramosissimus*. No trees occur in the area.

Table C146. Most Abundant Species

Stratum	Species
Shrub	*Larrea tridentata*
Herb	*Sporobolus flexuosus*

Other Noteworthy Species
Eragrostis lehmanniana is an introduced perennial grass species found at both sites, poorly represented or scattered.

Salsola tragus is an introduced annual forb species found scattered at one of the sites.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC080, 07YC083.
Local Description Authors: H. Varani

***Poliomintha incana / Sporobolus flexuosus* Shrubland**
Frosted Mint / Mesa Dropseed Shrubland (Table C147)

Identifier: CEPP006990

Table C147. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Sand Scrub Group [G287]
Association	*Poliomintha incana / Sporobolus flexuosus* Shrubland

Distribution
This infrequent association is known to occur in the gypsum dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This site occurs at an elevation of 3,702 ft (1,128 m). It occurs in an inter-dunal swale without rock or gravel; most of the ground surface is sand, with some litter and 10% cover of cryptograms. Geologic substrates are younger alluvial deposits.

Soils are classified as Lark-Peligro complex, one to 8% slopes (LPC) which are gypsic, thermic Typic Torripsamments or coarse gypseous, hypergypsic, thermic Leptic Haplogypsids relative to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

This low diversity, open shrubland association consists locally of five shrub species including *Psorothamnus scoparius* (poorly represented), and scattered *Poliomintha incana* (Table C148), and *Atriplex canescens*. *Prosopis glandulosa*, and *Yucca elata* occur nearby. Grasses are sparse and represented by three species, mostly *Sporobolus flexuosus*, but including *Bouteloua breviseta*, and *Sporobolus giganteus*. The only forb found onsite are bladderpods (*Lesquerella* spp.). No trees, cacti, or subshrubs occur at this site.

Table C148. Most Abundant Species

Stratum	Species
Shrub	*Poliomintha incana*
Herb	*Sporobolus flexuosus*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN023.
Local Description Authors: H. Varani

***Psorothamnus scoparius / Sporobolus flexuosus* Shrubland**

room Smokebush / Mesa Dropseed Shrubland (Table C149)

Identifier: CEGL001695

Table C149. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Sand Scrub Group [G287]
Association	*Psorothamnus scoparius / Sporobolus flexuosus* Shrubland

Distribution

This infrequent association is known to occur in the quartzose dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description

This association is recorded in the elevation range of 3,678 to 3,720 ft (1,121 to 1,134 m) and situated in a gently sloping landscape. Sites are coppiced and feature exposed sand between shrub mounds, with little rock or mixed alluvial gravel. Cryptogram growth occurs, as well as moss among shrub bases. Geologic substrates are younger alluvial deposits.

Soils are mapped as Copia loamy fine sand, 2 to 7% slopes (COC), (mixed, thermic Typic Torripsamments), and Monahans-Pajarito complex, 0 to 5% slopes () (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrubland association is composed of nine species, and may be dominated by *Prosopis glandulosa* though *Psorothamnus scoparius* is well represented (Table C150), and *Atriplex canescens* is common. The sparse herbaceous understory is dominated by the bunchgrass *Sporobolus flexuosus* and commonly alongside scattered *Sporobolus cryptandrus*, *Sporobolus giganteus*, and *Muhlenbergia porteri* or occasionally *Sporobolus contractus*, or *Achnatherum hymenoides*. Forbs are each generally scattered, and include 13 variable species; the most common are: *Sphaeralcea incana*, *Chamaesyce parryi*, and *Dimorphocarpa wislizeni*. Occasionally, understories also include *Yucca elata*, and *Gutierrezia sarothrae*. Trees do not occur in this association.

Table C150. Most Abundant Species

Stratum	Species
Shrub	*Psorothamnus scoparius*
Herb	*Sporobolus flexuosus*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ070, 07YC082, 10TN026.
Local Description Authors: H. Varani

G286 Chihuahuan Desert Succulent Scrub Group

***Acacia neovernicosa - Agave lechuguilla* Shrubland**

Viscid Acacia - Lechuguilla Shrubland (Table C151)

Identifier: CEPP006868

Table C151. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Succulent Scrub Group [G286]
Association	*Acacia neovernicosa - Agave lechuguilla* Shrubland

Distribution

An example of this association is known to occur in the Bajadas area of Guadalupe Mountains NP, very near and east of the Patterson Hills.

Environmental Description

This site is located at 4,560 ft (1,390 m) on a moderate, south facing slope. The site is gravely and rocky, and features small amounts (1% cover) of cryptogram growth. Geologic substrates at this site are older alluvial deposits.

The soil is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association features 40% shrub cover composed of ten species; these dominated by *Acacia neovernicosa* (Table C152)with occurrences of *Larrea tridentata* and *Viguiera stenoloba*. An additional 30% cover is composed of 11 subshrubs and cacti, mainly *Agave lechuguilla*, and *Parthenium incanum*. The sparse understory includes eight grass species and nine scattered forbs. *Bouteloua curtipendula* and *Bouteloua gracilis* are the most abundant, but do not exceed 3% cover. The 2% total forb cover is composed mainly of *Tridens muticus*, *Chamaesaracha texensis*, *Chamaesyce lata*, *Physaria fendleri*, and *Polygala macradenia*. No trees occur in this association.

Table C152. Most Abundant Species

Stratum	Species
Shrub	*Acacia neovernicosa*
Herb	*Agave lechuguilla*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database availableat https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC244.
Local Description Authors: H. Varani

***Fouquieria splendens - Tiquilia greggii* Shrubland**
Ocotillo - Plume Tiquilia Shrubland (Table C153)

Identifier: CEPP006887

Table C153. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Succulent Scrub Group [G286]
Association	*Fouquieria splendens - Tiquilia greggii* Shrubland

Distribution
This common association occurs in the Patterson Hills and Bajadas areas of Guadalupe Mountains NP, extending from PX Well to El Centro Draw.

Environmental Description
This association can be found in the elevations ranging from 3,835 to 4,557 ft (1,169 to 1,389 m) on gentle to moderate slopes with southerly and westerly aspects. Sites are rocky or bare and feature as much as 40% gravel cover and with average cryptogram cover approaching 7%. Generally, geologic substrates are older and younger alluvial deposits, with two sites occurring on the Capitan Limestone.

The soils are mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series) and Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) (loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrubland association is diverse and dominated by a combination of the shrub *Fouquieria splendens* and the subshrub *Tiquilia greggii* (Table C154). The shrub-layer is composed of a variety of 19 shrubs, averaging 15% cover, and most commonly including *Dasylirion leiophyllum*, and *Ephedra aspera* alongside the nominal species. The subshrub component also includes a variety of 19 species, averages 18% cover, and consistently includes the hedgehog cacti *Echinocereus dasyacanthus*, and *Echinocereus horizonthalonius* as well as the aforementioned dominant. Frequently *Krameria grayi*, *Opuntia phaeacantha* and *Thymophylla acerosa* are also present. The herbaceous combination of grasses and forbs averages 20% cover, generally grass dominated. The variety of 19 grass species is without a clear defining species, though *Bouteloua eriopoda* is consistently included, often alongside *Bouteloua curtipendula* and/or *Aristida divaricata*. Forbs similarly lack a defining species among the 30 species recorded; most often *Thymophylla pentachaeta* is represented, often alongside *Polygala macradenia* and/or *Bahia absinthifolia*. No trees occur in this association.

Table C154. Most Abundant Species

Stratum	Species
Shrub	*Fouquieria splendens*
Subshrub	*Tiquilia greggii*

Other Noteworthy Species

Mentzelia humilis var. *guadalupensis* is recognized in New Mexico as a rare plant. It is known to occur on open gypsum outcrops in southeastern Otero County, New Mexico, and the west slope of the Guadalupe Mountains, Texas. In this association it is infrequently present.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC243, 06YC249, 07CJ047, 07CJ061, 07YC029, 07YC049.
Local Description Authors: H. Varani

***Fouquieria splendens / Parthenium incanum* Shrubland**

Ocotillo / Mariola Shrubland (Table C155)

Identifier: CEGL001378

Table C155. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Desert Succulent Scrub Group [G286]
Association	*Fouquieria splendens* / *Parthenium incanum* Shrubland

Distribution
This infrequent association occurs in the Patterson Hills area of Guadalupe Mountains NP, east of El Centro Draw.

Environmental Description
This association is known to occur within the elevations ranging from 4,403 to 4,852 ft (1,342 to 1,479 m) on moderate to steep slopes of variable aspects. Sites are rocky and gravelly, or occasionally featuring substantial amounts of exposed soil, with little cryptogram growth. Geologic substrates include the Capitan and Carlsbad Limestones.

Soils are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) made up of loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association is dominated by *Fouquieria splendens* (Table C156) and includes abundant cover of *Viguiera stenoloba* and some amount of *Larrea tridentata*; the nine other shrub species recorded are scattered. Shrub cover can reach 50%, Subshrubs and cacti are generally less dense, but may reach 40%. The dominant species is *Parthenium incanum*, and the most commonly occurring of the 15 other species are *Tiquilia canescens*, *Echinocactus horizonthalonius*, *Echinocactus stramineus*, and *Escobaria tuberculosa*. Though not found at every site, *Agave lechuguilla* can be well represented. Grass cover rarely exceeds 10%, consistently including *Bouteloua eriopoda*, *Bouteloua curtipendula*, *Tridens muticus*, and *Sporobolus cryptandrus*. Forb cover occasionally reaches 10%, with nine of the ten recorded species occurring repeatedly; most consistent of these are *Thymophylla pentachaeta* and *Bahia absinthifolia*. No trees occur in this association.

Table C156. Most Abundant Species

Stratum	Species
Shrub	*Fouquieria splendens*
Subshrub	*Parthenium incanum*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ029, 07YC025, 07YC027, 07YC028.
Local Description Authors: H. Varani

G847 Chihuahuan Gypsophilous Scrub Group

A*triplex canescens / Muhlenbergia porteri - Sartwellia flaveriae* Shrubland
Fourwing Saltbush / Bush Muhly - Threadleaf Glowwort Shrubland (Table C157)

Identifier: CEPP006873

Table C157. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Gypsophilous Scrub Group [G847]
Association	*Atriplex canescens / Muhlenbergia porteri - Sartwellia flaveriae* Shrubland

Distribution
This infrequent association type occurs in the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
The association can be found in the elevations ranging from 3,638 to 3,684 ft (1,109 to 1,123 m) in the swales and playas of a flat landscape. Some areas have some eolian deposits. Sites feature up to 30% cover of exposed soils, 30% cover of cryptogrammic crust, and are partially concealed by litter cover (an average of 32%). Geologic substrates are of younger alluvial deposits in salt basins often forming gypsum soils.

Soils are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) made up of coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series), and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) and Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association features abundant shrub cover composed mainly of *Atriplex canescens* and including a variety of five other shrubs or subshrubs (Table C158). *Muhlenbergia porteri* is always present in the understory and may form most of the understory, and forbs are well represented, or *Sartwellia flaveriae* may be abundant, and grass cover sparse. A dozen other species are variable in the herbaceous layer including the dropseeds *Sporobolus nealleyi*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and *Sporobolus flexuosus*, and the forbs *Gutierrezia sphaerocephala*, *Lepidium alyssoides* var. *angustifolium*, or *Phacelia integrifolia* as examples. Trees do not occur in the area.

Table C158. Most Abundant Species

Stratum	Species
Shrub	*Atriplex canescens*
Herb	*Muhlenbergia porteri, Sartwellia flaveriae*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC061, 07YC067, 10TN024, 10TN025.
Local Description Authors: H. Varani

***Atriplex canescens / Sporobolus airoides / Sartwellia flaveriae* Shrubland**
Fourwing Saltbush / Alkali Sacaton / Threadleaf Glowwort Shrubland (Table C159)

Identifier: CEPP006875

Table C159. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Gypsophilous Scrub Group [G847]
Association	*Atriplex canescens* / *Sporobolus airoides* / *Sartwellia flaveriae* Shrubland

Distribution
This infrequent association occurs in the gypseous Salt Basin Dunes in the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association can be found at elevations from 4,403 to 4,852 ft (1,342 to 1,478 m). Sites feature an average of 28% bare sand, 20% cryptogram cover, and very little surface rock. They are found on soils formed from younger alluvial deposits.

Soils at these sites are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) made up of coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This open shrubland association is dominated by *Atriplex canescens* (Table C160). Six other shrub species are poorly represented in canopies that range from 10% to 20% cover; most commonly these include *Cylindropuntia leptocaulis* and *Ephedra torreyana*. Understory grasses range in cover from 7 to 25%, are dominated by *Sporobolus airoides* and include *Sporobolus nealleyi*, and frequently *Muhlenbergia porteri*. Cover of the forb *Sartwellia flaveriae* rivals grass totals, while the other six recorded forb species are scattered. Paddle cacti (*Opuntia phaeacantha*, *Opuntia polyacantha*, and *Opuntia macrocentra*) are also commonly scattered. Trees do not occur in this association.

Table C160. Most Abundant Species

Stratum	Species
Shrub	*Atriplex canescens*
Grass	*Sporobolus airoides*
Forb	*Sartwellia flaveriae*

Other Noteworthy Species
Salsola tragus is an introduced annual forb species that was found scattered at one site in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ072, 07YC059, 07YC070, 07YC071, 07YC072.
Local Description Authors: H. Varani

***Atriplex canescens / Sporobolus nealleyi* Shrubland**
Fourwing Saltbush / Gyp Dropseed Shrubland (Table C161)

Identifier: CEPP007287

Table C161. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Gypsophilous Scrub Group [G847]
Association	*Atriplex canescens* / *Sporobolus nealleyi* Shrubland

Distribution
This infrequent association can be found in the gypseous salt dunes in broken plains near the westernmost boundary of Guadalupe Mountains NP.

Environmental Description
This association is known to occur at 3,632 ft (1,107 m). Sites are not sloped, or sloped only very gently, and feature up to 50% cryptogram growth, as well as a substantial amount of bare soil and microphytic crust on gypsum soil surface. Geologic substrates are of gypsum deposits in salt basins often forming gypsum soils with shallow erosional channels (only several inches). Small sandy hummocks forming at base of some vegetation (mostly shrubs).

Soils are mapped as and Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This sparse shrubland association is dominated by *Atriplex canescens*, which can reach 10% cover (Table C162). This is the only species that exceeds 5% cover consistently. Other common shrubs include *Ephedra torreyana* and *Cylindropuntia leptocauli*. Of the 3% average cover made up of cacti and dwarf shrubs, the only common species between sites is *Tiquilia hispidissima*, *Opuntia polyacantha* also occurs at the other. Sparse understories consist of a combination of dwarf shrubs, grasses and forbs. Grasses average 3% cover and are dominated by *Sporobolus nealleyi*, rivaled by *Sporobolus airoides* at one site. The 5% forb cover is dominated by *Sartwellia flaveriae* and unrivaled. Trees do not occur in this association.

Table C162. Most Abundant Species

Stratum	Species
Shrub	*Atriplex canescens*
Herb	*Sporobolus airoides*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC057, 07YC065.
Local Description Authors: H. Varani

***Poliomintha incana / Andropogon hallii* Shrubland**
Frosted Mint / Sand Bluestem Shrubland (Table C163)

Identifier: CEPP006989

Table C163. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Gypsophilous Scrub Group [G847]
Association	*Poliomintha incana / Andropogon hallii* Shrubland

Distribution
This infrequent association is known to occur in the gypseous dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association is recorded at an elevation of 3,698 ft (1,127 m). The site is located in a dune field, with ground surfaces consisting almost entirely of gypsum sand. Geologic substrates are younger alluvial deposits.

Soil at the site is mapped as Lark-Peligro complex, one to 8% slopes (LPC) which are gypsic, thermic Typic Torripsamments or coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids relative to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This low diversity shrubland association grows in widely space patches among the sand dunes to the west of Guadalupe Mountains NP. Vegetative patches are dominated by the nominal shrub, *Poliomintha incana* (Table C164) and include scattered individuals of *Psorothamnus scoparius*, *Atriplex canescens*, and *Yucca elata*. The two grass species, *Andropogon hallii* and *Achnatherum hymenoides*, grow in clumps and as scattered individuals. No subshrubs or forbs occur at this site; trees do no occur in this association.

Table C164. Most Abundant Species

Stratum	Species
Shrub	*Poliomintha incana*
Herb	*Andropogon hallii*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC084.
Local Description Authors: H. Varani

***Poliomintha incana / Bouteloua breviseta* Gypsophilous Shrubland**
Frosted Mint / Gyp Grama Gypsophilous Shrubland (Table C165)

Identifier: CEPP007438

Table C165. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Desert Scrub (M086)
Group	Chihuahuan Gypsophilous Scrub Group [G847]
Association	*Poliomintha incana / Bouteloua breviseta* Gypsophilous Shrubland

Distribution
This infrequent association is known to occur in the gypseous sand dunes near the westernmost boundary of Guadalupe Mountains NP.

Environmental Description
This association is found in a low gypsum dune land at 3,632 ft (1,107 m). Ground surfaces at the site consist largely of exposed sand with minute amounts of litter and cryptogram growth, and are without gravel or rock. Geologic substrates are of younger alluvial deposits.

Soils are mapped as Lark-Peligro complex, one to 8% slopes (LPC) which are gypsic, thermic Typic Torripsamments or coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids relative to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
The woody component of this very open shrubland association is dominated by *Poliomintha incana* (Table C166) and includes scattered individuals of *Yucca elata* and *Ephedra torreyana* as well as the dwarf shrubs *Tiquilia hispidissima* and *Krameria grayi*. Grasses are abundant in the herbaceous layer, preferring the leeward dune slopes. They predominantly consist of *Bouteloua breviseta*, and include *Achnatherum hymenoides*, and *Andropogon hallii*. Six forb species are present at this site, totaling 1% cover and include *Thelesperma megapotamicum*, *Gaillardia multiceps*, *Mentzelia humilis* var. *guadalupensis*, *Nama carnosum*, *Selinocarpus lanceolatus*, *Xanthisma spinulosum*, and *Nerisyrenia linearifolia*. No trees occur in this association.

Table C166. Most Abundant Species

Stratum	Species
Shrub	*Poliomintha incana*
Herb	*Bouteloua breviseta*

Other Noteworthy Species
Mentzelia humilis var. *guadalupensis* is recognized in New Mexico as a rare plant that is scattered in this association. It is known to occur on open gypsum outcrops in southeastern Otero County, New Mexico, and the west slope of the Guadalupe Mountains, Texas.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 007YC063.
Local Description Authors: H. Varani

G490 Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group

This group is a broadly defined desert grassland (shrub-steppe) that is typical of the Borderlands of Arizona, New Mexico and northern Mexico and extending throughout much of the Chihuahuan Desert west to the Sonoran Desert, and north to the Mogollon Rim. The vegetation is characterized by an open to dense herbaceous layer dominated by a diverse mixture of perennial desert grasses. Scattered shrubs and succulents are usually present, but usually have lower total cover than the herbaceous layer. Common species include desert grasses such as *Bouteloua eriopoda*, *Bouteloua ramosa*, *Bouteloua rothrockii*, *Muhlenbergia porteri*, as well as widespread species *Bouteloua curtipendula*, *Bouteloua gracilis*, *Bouteloua hirsuta*, and *Eragrostis intermedia*. Also typical are succulents such as *Agave lechuguilla*, rosetophyllous shrubs such as species of *Nolina*, *Dasylirion*, and *Yucca*, and short (dwarf) shrubs including species of *Calliandra*, *Mimosa*, and *Parthenium*. Scattered tall shrubs and short trees such as species of *Acacia*, *Prosopis*, and various oaks may be present but with low cover. In upper foothills and lower montane zones *Muhlenbergia emersleyi* and *Muhlenbergia setifolia* are characteristic species. Sites occur on gently sloping alluvial erosional fans and piedmonts (bajadas) that lie along mountain fronts of the isolated basin ranges (e.g., Sky Island mountain archipelago) extending onto foothill slopes up to 5,479 ft (1670 m) elevation in the Chihuahuan Desert.

Many of the historical desert grassland and savanna areas have been converted through intensive grazing and other land uses, some to North American Warm Desert Ruderal Scrub Group (G819) (*Prosopis* spp.-dominated) or Chihuahuan Creosotebush - Mixed Desert Scrub Group (G288) (*Larrea tridentata*-dominated).

Agave lechuguilla / Bouteloua eriopoda Dwarf-shrubland

Lechuguilla / Black Grama Dwarf-Shrubland (Table C167)

Identifier: CEPP006872

Table C167. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Agave lechuguilla / Bouteloua eriopoda* Dwarf-shrubland

Distribution
This infrequent association can be found in the Bajadas area near the southern boundary of Guadalupe Mountains NP.

Environmental Description
This association is recorded at an elevation of 4,363 ft (1,330 m) on a moderate, west facing slope. At this site, vegetation emerges from cracks in a rocky ground surface. Geologic substrates at the site are from the Lamar limestone member of the Bell Canyon Formation.

The soil here is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD), made up of loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This sparse shrubland is dominated by *Agave lechuguilla*, in excess of 5% cover (Table C168). The understory is dominated by the poorly represented annual grass, *Bouteloua eriopoda*; the two other grasses present are perennial grasses including threeawn, (*Aristida* spp.) and *Bouteloua curtipendula*. Scattered among the lechuguilla are four shrub species: *Fouquieria splendens*, *Viguiera stenoloba*, *Condalia ericoides*, and *Ephedra torreyana*; pricklypear (*Opuntia* spp.) is present as well. Growing nearby are *Parthenium incanum*, *Acacia neovernicosa*, and *Dalea formosa*. No trees occur at this site.

Table C168. Most Abundant Species

Stratum	Species
Subshrub	*Agave lechuguilla*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN029.
Local Description Authors: H. Varani

***Bouteloua eriopoda - Bouteloua curtipendula* Grassland**
Black Grama - Sideoats Grama Grassland (Table C169)

Identifier: CEGL001747

Table C169. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Bouteloua eriopoda - Bouteloua curtipendula* Grassland

Distribution
This common association is found in the Bajadas area east of the Patterson Hills, and the Guadalupe Pass area of Guadalupe Mountains NP.

Environmental Description
This association occurs in the elevations ranging from 4,459 to 5,302 ft (1,359 to 1,616 m) on very gentle to moderate slopes. Sites are generally gravelly (averaging 44% gravel cover), and may feature rock, or exposed soils in the vegetated interspaces. Geological substrates are of younger and older alluvial deposits as well as the Cherry Canyon Formation and Capitan Limestones.

Soils are primarily mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series) with one site on soil classified as Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This herbaceous association averages 32% grass cover codominated by *Bouteloua curtipendula* and *Bouteloua eriopoda* (Table C170), with the remaining 14 species as poorly represented or scattered, most commonly including *Aristida divaricata*, *Bouteloua hirsuta*, *Munroa squarrosa*, and *Tridens muticus*. Forbs are generally poorly represented (ranging from absent to 8% cover), and of the 17 species, the most common are *Thymophylla pentachaeta*, *Polygala macradenia*, and *Houstonia acerosa* var. *polypremoides*. Twenty shrub species average 6% cover and generally include *Yucca elata* and *Larrea tridentata*. Less frequently *Condalia ericoides*, *Mortonia scabrella*, and/or *Nolina texana* are poorly represented. The variety of 15 subshrubs and cacti species are poorly represented, the most frequently included are *Krameria grayi*, *Tiquilia hispidissima*, *Opuntia phaeacantha*, *Thymophylla acerosa*, *Echinocactus horizonthalonius*, and *Echinocactus dasyacanthus*. Trees do not occur in this association.

Table C170. Most Abundant Species

Stratum	Species
Herb	*Bouteloua curtipendula, Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC240, 06YC246, 06YC253, 07YC040, 10TN030 .
Local Description Authors: H. Varani

***Bouteloua eriopoda - Bouteloua gracilis* Grassland**
Black Grama - Blue Grama Grassland (Table C171)

Identifier: CEGL001748

Table C171. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Bouteloua eriopoda - Bouteloua gracilis* Grassland

Distribution
This common association occurs on the lower slopes of the Eastern Escarpment in the Guadalupe Pass, Eastern Alluvial Uplands and Pine Spring Canyon areas of Guadalupe Mountains NP. It extends along the escarpment from Nipple Hill to south of Guadalupe Spring, and as east as the park boundary.

Environmental Description
This association is known to occur in the elevation range of 5,190 to 5,655 ft (1,582 to 1,724 m) on gentle to moderately steep (with one site on an atypically steep slope), colluvial slopes. Slopes have southern or eastern aspects, and feature an average of 17% gravel cover, and 14% cover of bare soil. Geologic substrates include the Cherry Canyon Formation, and older alluvial deposits with one site on younger alluvial deposits.

Soils are mapped in the three following units (in order of predominance among sites): Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents), Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), and McKittrick-Riverwash complex soils 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This herbaceous association averages more than 50% grass cover, dominated by *Bouteloua eriopoda* with *Bouteloua gracilis* as the codominant (Table C172). Off the 26 other species, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Lycurus setosus*, and *Aristida purpurea* var. *wrightii* are common. Forbs rarely exceed 5% total cover and of the 51 forb species, *Melampodium leucanthum* is the most common, followed by *Croton pottsii*, *Xanthisma spinulosum*, *Chamaesyce lata*, and *Zinnia grandiflora*. The woody component of this association is sometimes absent, and varies, both shrub and subshrubs can be poorly represented or abundant. The most common shrubs, *Cylindropuntia imbricata* and *Yucca elata*, are often components of a shrub canopy that may be dominated by *Rhus microphylla*, *Viguiera stenoloba*, *Prosopis glandulosa*, or *Krascheninnikovia lanata*. Subshrubs are dominated by *Gutierrezia sarothrae* an may include two dozen other species. Trees are rare in this association, sometimes represented in the shrub layer by *Juniperus pinchotii*, or *Juniperus deppeana*.

Table C172. Most Abundant Species

Stratum	Species
Herb	*Bouteloua eriopoda, Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC194, 06YC195, 07CJ039, 07CJ040, 07YC018, 07YC038, 08GM010, 10TN003, 10TN033.
Local Description Authors: H. Varani

Bouteloua eriopoda - Hesperostipa neomexicana Grassland

Black Grama - New Mexico Needlegrass Grassland (Table C173)

Identifier: CEGL001753

Table C173. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Bouteloua eriopoda - Hesperostipa neomexicana* Grassland

Distribution

This association is known to occur near the mouth of Pine Spring Canyon in Guadalupe Mountains NP.

Environmental Description

This association occurs at 5,768 ft (1,758 m) on a gentle, south facing nose-slope. The site features some gravel, exposed soil, and litter in the grass interspaces. Geologic substrate at the site is of the Cherry Canyon Formation.

Soil at the site is mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description

This herbaceous association features very abundant cover of *Hesperostipa neomexicana* and includes *Bouteloua eriopoda* (Table C174) with the scattered presence of *Lycurus setosus* and the forb *Verbena perennis*. A woody component of this association occurs at this site, consisting of three scattered shrub species and two scattered subshrub species as follows: *Acacia neovernicosa*, *Viguiera stenoloba*, *Yucca elata*, *Gutierrezia sarothrae*, and *Parthenium incanum*. No trees occur in this association though *Quercus* × *pauciloba* grows in surrounding areas.

Table C174. Most Abundant Species

Stratum	Species
Herb	*Hesperostipa neomexicana, Bouteloua eriopoda*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08SS022.
Local Description Authors: H. Varani

***Bouteloua eriopoda - Muhlenbergia porteri* Grassland**
Black Grama - Bush Muhly Grassland (Table C175)

Identifier: CEPP006877

Table C175. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Bouteloua eriopoda - Muhlenbergia porteri* Grassland

Distribution
This infrequent association is known to exist west of Cutoff Ridge in the Western Escarpment area of Guadalupe Mountains NP.

Environmental Description
This association occurs as a small herbaceous inclusion of a larger shrubland at 4,570 ft (1,393 m). The site is on a moderate, northwest facing slope, and features 35% cover of gravel and exposed soil, and 10% cover of cryptogrammic crusts. Geologic substrates are of the Victorio Peak gray member of the Bone Spring Limestone.

Soil at the site is mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG), made up of loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
This herbaceous association is a perennial grassland featuring 50% grass cover. *Bouteloua eriopoda* is very abundant and *Muhlenbergia porteri* is well represented (Table C176). Of the six additional species, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Panicum hallii* and *Sporobolus contractus* all exceed 1% cover. The combination of the eight mostly scattered forb species covers 5% (*Sartwellia flaveriae*, and *Thymophylla pentachaeta* exceed 1% cover). Shrubs and subshrubs are well represented, reaching 15% cover when combined, mostly composed of *Atriplex canescens* and *Gutierrezia sarothrae*. Trees do not occur at this site.

Table C176. Most Abundant Species

Stratum	Species
Herb	*Bouteloua eriopoda, Muhlenbergia porteri*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ044.
Local Description Authors: H. Varani

***Dasylirion leiophyllum - Agave lechuguilla / Muhlenbergia setifolia* Shrub Grassland**
Green Sotol - Lechuguilla / Curlyleaf Muhly Shrub Grassland (Table C177)

Identifier: CEPP006881

Table C177. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Dasylirion leiophyllum - Agave lechuguilla / Muhlenbergia setifolia* Shrub Grassland

Distribution
This infrequent association is known to occur on the canyon wall near the mouth of McKittrick Canyon in Guadalupe Mountains NP.

Environmental Description
This association is recorded at an elevation of 5,341 ft (1,628 m), and occurs on a steep, rocky (50% cover), south facing escarpment. The geologic substrate is of the Capitan Limestone.

Soil at the site is classified as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH), which are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association consists of an open shrub canopy of 11 species, dominated by the abundant *Viguiera stenoloba* with *Quercus pungens* well represented, and *Dasylirion leiophyllum*, *Opuntia engelmannii*, and *Quercus* × *pauciloba* each exceeding 1% cover (Table C178). Subshrubs cover 8% and include 11 species, predominantly represented by *Agave lechuguilla*, *Dalea bicolor* var. *argyraea*, and *Gutierrezia sarothrae*. *Muhlenbergia setifolia* is abundant among the 14 recorded grass species which also include *Bouteloua curtipendula*, *Eragrostis intermedia*, *Muhlenbergia emersleyi*, and *Muhlenbergia tenuifolia*. Total cover by the grasses reaches 25%. Of the 15 scattered forbs covering 3% total, only *Astrolepis cochisensis* exceeds 1% at this site. *Artemisia ludoviciana*, *Chaetopappa ericoides*, *Croton dioicus*, *Erigeron flagellaris*, *Tragia ramosa*, and *Viguiera dentata* are a few additional examples. Though mature canopy trees do not occur at this site, regeneration of *Juniperus pinchotii* is well represented in the shrub canopy.

Table C178. Most Abundant Species

Stratum	Species
Shrub	*Dasylirion leiophyllum*
Subshrub	*Agave lechuguilla*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species
Euphorbia davidii is an introduced annual forb present at this site.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC226.
Local Description Authors: H. Varani

***Dasylirion leiophyllum / Bouteloua curtipendula* Shrub Grassland**
Green Sotol / Sideoats Grama Shrub Grassland (Table C179)

Identifier: CEPP006882

Table C179. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Dasylirion leiophyllum / Bouteloua curtipendula* Shrub Grassland

Distribution
This common association can be found in the Patterson Hills and Western Escarpment areas of Guadalupe Mountains NP.

Environmental Description
Occurring within the elevations of 4,439 to 5,610 ft (1,353 to 1,709 m), on steep to very steep colluvial slopes, generally with northern aspects. Sites are rocky and gravelly, with minute amount of cryptogram growth. Geologic substrates are primarily of the Capitan Limestone, but include the Cherry Canyon Formation and Victorio Peak gray member of the Bone Spring Limestone as well.

Soils are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG), loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrub herbaceous association is open (averaging 20% shrub cover) and diverse with 93 associated species. The 20 recorded shrub species may be dominated by *Mortonia scabrella* or *Dasylirion leiophyllum* (Table C180) and includes *Viguiera stenoloba*, and *Leucophyllum minus* while the remaining species are generally scattered. Subshrubs and cacti are also well represented as a group, including 19 species. Most commonly included are *Krameria grayi*, *Opuntia phaeacantha*, and *Thymophylla acerosa*, though occasionally *Gutierrezia sarothrae* exceeds 5% cover. Grasses are abundant and composed mostly by *Bouteloua curtipendula*; they include *Muhlenbergia setifolia*. Of the 14 other poorly represented and scattered species *Bouteloua eriopoda*, *Tridens muticus*, and *Sporobolus cryptandrus* are the most common (*Bouteloua hirsuta* is occasionally well represented). Forbs rarely exceed 5% total cover (most are scattered), and occur inconsistently with *Astrolepis cochisensis*, *Selaginella wrightii*, *Bahia absinthifolia*, and *Thymophylla pentachaeta* as the most common. No trees occur in this association.

Table C180. Most Abundant Species

Stratum	Species
Shrub	*Dasylirion leiophyllum*
Herb	*Bouteloua curtipendula*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database availableat https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC250, 06YC251, 07CJ060, 07YC024, 07YC042.
Local Description Authors: H. Varani

Likely synonomous with CEGL001593 Dasylirion wheeleri / *Bouteloua curtipendula* Shrub Grassland

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***Dasylirion leiophyllum / Muhlenbergia emersleyi* Shrub Grassland**
Green Sotol / Bullgrass Shrub Grassland (Table C181)

Identifier: CEPP006883

Table C181. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Dasylirion leiophyllum / Muhlenbergia emersleyi* Shrub Grassland

Distribution
This infrequent association can be found in West Dog and Pine Spring Canyons of Guadalupe Mountains NP.

Environmental Description
This association is known to occur at 6,132 and 6,621 ft (1,869 and 2,018 m) on steep colluvial slopes, with southern aspects. Sites are equally rocky as gravelly, with some soil exposure and litter among the rocks and in the vegetated interspaces. Geologic substrates are of the Carlsbad Limestone and Cherry Canyon Formations.

Soils are mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls) and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrub herbaceous association is open and dominated by grasses; specifically *Muhlenbergia emersleyi* is very abundant (Table C182). Of the other 17 recorded species, *Bouteloua curtipendula* is well represented, and *Eragrostis intermedia*, *Aristida purpurea* var. *wrightii*, and *Bothriochloa barbinodis* are common, if poorly represented. Forbs are poorly represented and include 21 species of which *Artemisia ludoviciana* is the only one that exceeds 1% cover. Other common species are *Parthenium confertum* var. *lyratum*, *Melampodium leucanthum*, and *Schoenocrambe linearifolia*. Shrubs are abundant and dispersed across the slopes. *Dasylirion leiophyllum* is the dominant, though *Nolina texana*, and *Viguiera stenoloba* sometimes rival this. Also common, *Baccharis pteronioides*, and *Quercus* × *pauciloba* don't exceed 1% cover. Subshrubs are poorly represented and variable from site to site, consisting of six species that include equal proportions of *Ageratina wrightii*, *Chrysactinia mexicana*, *Menodora longiflora*, and *Parthenium incanum*. Tree cover is minute, represented by regeneration of *Arbutus xalapensis*, *Juniperus deppeana*, and *Quercus grisea*.

Table C182. Most Abundant Species

Stratum	Species
Shrub	*Dasylirion leiophyllum*
Herb	*Muhlenbergia emersleyi*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC032, 07CJ010, 08CJ031.
Local Description Authors: H. Varani

***Dasylirion leiophyllum / Muhlenbergia setifolia* Shrub Grassland**
Green Sotol / Curlyleaf Muhly Shrub Grassland (Table C183)

Identifier: CEPP006884

Table C183. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Dasylirion leiophyllum / Muhlenbergia setifolia* Shrub Grassland

Distribution
This very common association is scattered through the Eastern Escarpment, Patterson Hills, and the Mountain High Country (near West Dog Canyon) of Guadalupe Mountains NP.

Environmental Description
This association occurs within the range of 4,559 to 6,640 ft (1,389 to 1,555 m) on moderate to steep colluvial slopes (one site occurs atypically on a gentle toe-slope). Sites are situated across southerly slope faces and are very rocky and gravelly, with a small amount of exposed soil and litter under the vegetation. Geologic substrates include the Goat Seep, Capitan, and Carlsbad Limestones, the Cherry Canyon Formation (and Manzanita limestone member), the Lamar limestone member of the Bell Canyon Formation, and older alluvial deposits.

Soils have been mapped as primarily as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), and Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH). PCG soils are very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic. LRH soils are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls. Minor soil units include Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls), Bissett-Rock outcrop complex, 15-60% slopes (BRG) (loamy-skeletal, mixed, superactive thermic Lithic Ustic Haplocalcids) and Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This diverse shrub herbaceous association is most often herbaceous in character, though grass cover ranges widely from 6% to 80% (averaging at 30%). Of the 29 variable grass species recorded *Muhlenbergia setifolia* is most commonly the dominant and may be luxurious (Table C184). *Lycurus setosus*, *Bouteloua curtipendula*, *Eragrostis intermedia*, and *Bouteloua hirsuta* occur commonly and occasionally *Muhlenbergia emersleyi* is abundant. A variety of 67 forb species average less than 5% total cover; *Astrolepis cochisensis*, *Eriogonum hieraciifolium*, *Viguiera dentata*,

and *Melampodium leucanthum* are the most common. The woody component is open (averaging 20% shrub and subshrub cover), with *Dasylirion leiophyllum* as the dominant species among the 20 recorded shrubs. Commonly *Viguiera stenoloba*, *Nolina texana*, and *Opuntia engelmannii* are also included, while the rest are variable. Subshrubs and cacti cover is lighter; most frequently, *Opuntia phaeacantha*, *Agave parryi* ssp. *neomexicana*, and *Parthenium incanum* are among the 23 variable species. Trees occur infrequently and are represented by *Pinus edulis*, *Quercus grisea*, *Juniperus pinchotii,* and *Juniperus deppeana*.

Table C184. Most Abundant Species

Stratum	Species
Shrub	*Dasylirion leiophyllum*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database availableat https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC183, 06YC198, 06YC231, 07CJ001, 07PA003, 07PA010, 07YC011, 07YC014, 07YC026, 07YC033, 08SS025, 10TN031.
Local Description Authors: H. Varani

Likely synonymous with CEGL001512 *Dasylirion wheeleri* / *Muhlenbergia setifolia* Shrub Grassland.

***Fouquieria splendens / Bouteloua curtipendula* Shrub Grassland**
Ocotillo / Sideoats Grama Shrub Grassland (Table C185)

Identifier: CEPP006888

Table C185. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Fouquieria splendens* / *Bouteloua curtipendula* Shrub Grassland

Distribution
This infrequent association is known from the foothills west of Cutoff Ridge, in the Western Escarpment area of Guadalupe Mountains NP.

Environmental Description
This association occurs on a moderately sloped top ridge of an alluvial remnant, and on a steep colluvial drainage/valley side-slope, at the respective elevations of 4,278 and 4,652 ft (1,304 and 1,418 m). Slopes are westerly in aspect. Sites are rocky with abundant gravel, and minor amounts of soil exposure or litter. Ground surfaces on the moderately sloped site feature 10% cryptogram cover. Geologic substrates are of the Victorio Peak gray member of the Bone Spring Limestone.

Soils at the sites are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) made up of loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrub herbaceous association is mainly woody in character, featuring 30% shrub cover dominated by *Fouquieria splendens* (Table C186) and often codominated by *Dasylirion leiophyllum*. Of the dozen other species recorded, *Leucophyllum minus*, *Ephedra aspera*, *Mortonia scabrella*, and *Viguiera stenoloba* are poorly represented and *Yucca torreyi* is scattered. The 10% subshrub and cacti cover is predominantly composed of *Menodora scabra*, and *Opuntia phaeacantha* and includes *Parthenium incanum* and *Escobaria tuberculosa* among a variety of the other ten other recorded species that are scattered among the grasses. The very abundant herbaceous layer consists of a combination of 11 grass species and 18 forb species. The dominant is a grass, *Bouteloua curtipendula*, which is well represented while *Aristida purpurea*, *Panicum hallii*, *Bouteloua eriopoda*, and *Tridens muticus* are poorly represented or scattered. Forbs vary, may be poorly represented or rival grasses in cover, and include *Chamaesaracha arida* and *Astrolepis cochisensis*. Trees do not occur in this association.

Table C186. Most Abundant Species

Stratum	Species
Shrub	*Fouquieria splendens*
Herb	*Bouteloua curtipendula*

Other Noteworthy Species

Nama xylopodum is classified as a New Mexico rare plant that is scattered at one of the sites in this association type. Generally it prefers partially shaded limestone cliffs and outcrops in montane scrub to piñon-juniper-oak woodland and occurs in Eddy, Otero, and Chaves counties in New Mexico, and in El Paso and Culberson counties of Texas in the Franklin and Guadalupe mountains.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ043, 07CJ055.
Local Description Authors: H. Varani

***Fouquieria splendens / Bouteloua eriopoda* Shrub Grassland**

Ocotillo / Black Grama Shrub Grassland (Table C187)

Identifier: CEPP006889

Table C187. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Fouquieria splendens / Bouteloua eriopoda* Shrub Grassland

Distribution

This infrequent association is known to occur in the Patterson Hills area of Guadalupe Mountains NP.

Environmental Description

This association is situated at 4,610 ft (1,405 m) on a lower north facing colluvial slope. The site is steep and gravely, with exposed soil, litter and rock (and a small amount of cryptogram growth) found between the bunchgrasses and other vegetation. Geologic substrates are of the Capitan Limestone.

Soil at the site is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
Fouquieria splendens is the dominant species in this very open shrub herbaceous association, covering nearly 30% (Table C188). Seven other species occur, with *Dasylirion leiophyllum*, *Larrea tridentata*, and *Yucca elata* exceeding 1% cover. Subshrubs and cacti are well-represented including *Krameria grayi*, and *Tiquilia hispidissima*. The herbaceous layer is composed of 10% grass cover and 8% forb cover (10 recorded species). The four recorded grass species are dominated by *Bouteloua eriopoda* though *Aristida divaricata* and *Bouteloua curtipendula* also exceed 1% cover. Of the ten recorded forb species only *Linum vernale* exceeds 1% cover, with *Croton dioicus* and *Physaria fendleri* as two other examples of species present. Trees do not occur in this association.

Table C188. Most Abundant Species

Stratum	Species
Shrub	*Fouquieria splendens*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC023.
Local Description Authors: H. Varani

***Hesperostipa neomexicana - Bouteloua curtipendula* Grassland**
New Mexico Feathergrass / Sideoats Grama Grassland (Table C189)

Identifier: CEGL001709

Table C189. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Hesperostipa neomexicana - Bouteloua curtipendula* Grassland

Distribution
This infrequent association is known to occur in West Dog Canyon of the Basin and Range area of Guadalupe Mountains National Park, very near the northernmost park boundary.

Environmental Description
This association occurs on a west facing, colluvial foot-slope at 6,296 ft (1,920 m). The site is situated on a moderate slope, and is rocky and gravelly with some litter in patches among the vegetation. Geologic substrate is the Carlsbad Limestone Formation.

Soils are mapped as Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This luxuriant grassland site features a very abundant cover of the warm season bunch grass *Eragrostis intermedia* and the cool season bunchgrass *Hesperostipa neomexicana* with the warm season species *Aristida purpurea* var. *nealley*i and *Bouteloua curtipendula* well represented (as well as the few other scattered species; Table C190)). All other life forms are poorly represented. The 14 forb species are all scattered including *Eriogonum hieraciifolium*, *Paronychia jamesii*, and *Viguiera dentata*. The nine species of shrubs and sub-shrubs (including cacti) are also scattered and include as examples: *Cercocarpus montanus* var. *paucidentatus*, *Opuntia engelmannii*, and *Rhus trilobata* among the shrubs and *Gutierrezia sarothrae* and *Menodora longiflora* among the sub-shrubs. Trees do not occur at this site, although *Juniperus deppeana* occurs nearby.

Table C190. Most Abundant Species

Stratum	Species
Herb	*Hesperostipa neomexicana, Bouteloua curtipendula*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07PA009.
Local Description Authors: H. Varani

***Hesperostipa neomexicana - Dasylirion wheeleri* Grassland**
New Mexico Feathergrass - Common Sotol Grassland (Table C191)

Identifier: CEGL001710

Table C191. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Hesperostipa neomexicana - Dasylirion wheeleri* Grassland

Distribution
This infrequent association is known to occur near the mouth of Pine Spring Canyon in the Guadalupe Pass area of Guadalupe Mountains NP.

Environmental Description
This association is found at 5,721 ft (1,745 m) on a gentle southerly slope. The slope burned in 1993, leaving many tree snags strewn across the slope. Ground surfaces at the site are concealed by litter among the luxuriant herbaceous vegetation. Geologic substrates are older alluvial deposits.

Soil at the site is mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description

This grassland association features abundant cover of *Hesperostipa neomexicana* (20%) with an open shrub layer characterized by *Dasylirion leiophyllum* (Table C192) with scattered *Nolina texana*, *Rhus trilobata* and other shrubs and dwarf-shrubs such as *Dalea formosa*, *Gutierrezia sarothrae*, *Mimosa aculeaticarpa* var. *biuncifera*, *Opuntia engelmannii* and *Yucca elata*. Herbaceous associates, *Bouteloua gracilis* and *Schizachyrium scoparium* are the two other grasses found at the site, each exceeding 1%. Forbs are not an important element of the herbaceous layer. Trees are sparse in this association, likely represented by *Juniperus deppeana*, and/or *Juniperus pinchotii*.

Table C192. Most Abundant Species

Stratum	Species
Shrub	*Dasylirion leiophyllum*
Herb	*Hesperostipa neomexicana*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN002.
Local Description Authors: H. Varani

***Krameria grayi / Dasyochloa pulchella* Dwarf-shrub Grassland**

White Ratany / Fluffgrass Dwarf-shrub Grassland (Table C193)

Identifier: CEPP006894

Table C193. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Krameria grayi / Dasyochloa pulchella* Dwarf-shrub Grassland

Distribution

This infrequent association is known from the Bajadas area of Guadalupe Mountains NP, occurring near the northernmost park boundary.

Environmental Description

This association occurs at elevations of 3,770 and 3,862 ft (1,149 to 1,177 m) on upper bajadas with gravelly surfaces and gentle slopes. Ground surfaces feature 40% gravel cover and nearly 30% exposed soil cover, and a small amount of cryptogrammic crusts (2% cover). Geologic substrates are younger alluvial deposits.

Soils are mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD), which are loamy-skeletal (or fine-loamy), mixed, superactive, thermic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description

Grasses are abundant in this dwarf-shrub herbaceous association, and dominated by *Dasyochloa pulchella* (Table C194). Other common species include *Setaria leucopila*, *Aristida purpurea*, *Bouteloua eriopoda*, and *Sporobolus cryptandrus*. Forbs exceed 5% cover at both site, the six species are dominated by *Bahia absinthifolia* and *Thymophylla pentachaeta*. Subshrubs are well represented at both sites, the nine species dominated by *Krameria grayi*, and including *Grusonia grahamii*, *Tiquilia hispidissima*, *Opuntia phaeacantha*, and *Echinocereus dasyacanthus*. Shrubs reach 5% cover with *Fouquieria splendens* poorly represented at each site, and *Cylindropuntia leptocaulis*, *Larrea tridentata*, *Prosopis glandulosa*, and *Yucca torreyi* commonly scattered. Trees do not occur in this landscape.

Table C194. Most Abundant Species

Stratum	Species
Subshrub	*Krameria grayi*
Herb	*Dasyochloa pulchella*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC050, 07YC052.
Local Description Authors: H. Varanii

Mimosa aculeaticarpa var. biuncifera / Bouteloua curtipendula Shrub Grassland

Catclaw Mimosa / Sideoats Grama Shrub Grassland (Table C195)

Identifier: CEPP006898

Table C195. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Mimosa aculeaticarpa* var. *biuncifera* / *Bouteloua curtipendula* Shrub Grassland

Distribution

This infrequent association can be found on the foot-slopes of the Eastern Escarpment and in the mouth of Pine Spring Canyon in Guadalupe Mountains NP.

Environmental Description

This association occurs on drainage terraces, and arroyo benches in the elevation range of 5,266 to 6,079 ft (1,605 to 1,853 m). On gentle to moderate southerly slopes, sites are generally densely vegetated, and sometimes rocky and gravelly with some cryptogrammic crusts, other times with ground surfaces largely concealed by litter. Geologic substrates are of older alluvial deposits as well as the Cherry and Bell Canyon Formations.

Soils are mapped primarily as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) with one site mapped as McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This diverse shrubland association features an abundant to luxuriant shrub canopy. The dominant *Mimosa aculeaticarpa* var. *biuncifera* is abundant (Table C196) and occurs alongside *Rhus trilobata* and *Cylindropuntia imbricata*, each poorly represented. Of the 13 other species, *Opuntia engelmannii*, *Dasylirion leiophyllum*, and *Viguiera stenoloba* can be well represented or abundant and are common. Subshrubs occur but never exceed 5% cover and are represented by *Gutierrezia sarothrae* most commonly, *Parthenium incanum*, and *Opuntia phaeacantha* occasionally. In the understory, grass cover is very abundant or luxuriant, the 23 species most commonly dominated by *Bouteloua curtipendula* and including *Eragrostis intermedia*. Other common and sometimes well represented species include *Bouteloua gracilis*, *Leptochloa dubia*, *Lycurus setosus*, *Muhlenbergia pauciflora* (dominant at one site), *Muhlenbergia emersleyi*, and *Setaria leucopila*. Forbs are variable in composition; of the 41 species, only *Parthenium confertum* var. *lyratum*, and *Artemisia ludoviciana* are found at all the sites, and only *Viguiera cordifolia* is not poorly represented or scattered (covering nearly 30% at one site). Trees may be absent or cover as much as 10%, and are represented by a variety of growth stages of *Quercus grisea*, *Juniperus pinchotii*, and *Juniperus deppeana*.

Table C196. Most Abundant Species

Stratum	Species
Shrub	*Mimosa aculeaticarpa* var. *biuncifera*
Herb	*Bouteloua curtipendula*

Other Noteworthy Species

*Marrubium vulgar*e (a perennial) is an introduced forb species and poorly represented associate at one site, *Ipomoea purpurea* (an annual) is also an introduced forb species, is scattered at another site.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC189, 06YC202, 07CJ026, 07YC034.
Local Description Authors: H. Varani

***Muhlenbergia setifolia - Bouteloua eriopoda* Grassland**

Curlyleaf Muhly - Black Grama Grassland (Table C197)

Identifier: CEPP006930

Table C197. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Muhlenbergia setifolia - Bouteloua eriopoda* Grassland

Distribution

This infrequent association is found on the toe slopes of the Eastern Escapement near Guadalupe Pass in Guadalupe Mountains NP.

Environmental Description
This association is found on gentle to moderate, southeasterly slopes in the elevations ranging from 5,702 to 5,850 ft (1,738 to 1,783 m). Sites feature some patches of gravel and rock among the luxuriant graminoids, with substrates of the Brushy Canyon Formation and younger alluvial deposits.

Soils are mapped as The Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents), and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This perennial grassland features luxuriant grass cover dominated by *Bouteloua eriopoda*, and featuring abundant cover of *Muhlenbergia setifolia* (Table C198). Consistently included among the 14 other potential grass species, *Bouteloua curtipendula* is well represented, and *Hesperostipa neomexicana* is present. Forbs are a minor component of this herbaceous association, reaching 1% cover and including *Polygala scoparioides* among the variety of 18 native and perennial species recorded. Shrubs, subshrubs and cacti are dispersed into each site, with the eight shorter varieties outnumbering the shrubs (subshrubs and cacti can reach 15% cover). *Gutierrezia sarothrae* is represented at each site, and commonly *Dalea formosa*, *Parthenium incanum*, *Opuntia phaeacantha*, *Agave parryi* ssp. *neomexicana*, and *Echinocereus viridiflorus* are included. Of the varieties that are generally taller than 0.5m, 13 species are recorded (occasionally reaching 10% cover), consistently including *Viguiera stenoloba*, *Yucca elata*, and *Dasylirion leiophyllum*. Trees do not occur in this association.

Table C198. Most Abundant Species

Stratum	Species
Herb	*Bouteloua eriopoda, Muhlenbergia setifolia*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC021, 07YC045, 07YC046.
Local Description Authors: H. Varani

***Nassella tenuissima - Bouteloua gracilis* Grassland**
Finestem Needlegrass - Blue Grama Grassland (Table C199)

Identifier: CEPP006931

Table C199. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Nassella tenuissima - Bouteloua gracilis* Grassland

Distribution
This common association is scattered east of cutoff ridge in the Basin and Range area of Guadalupe Mountains NP.

Environmental Description
This association is found in elevations from 6,204 to 6,759 ft (1,891 to 2,060 m) and occurs on very gentle (nearly flat) slopes of variable aspect. Vegetated interspaces are generally concealed by litter (average litter cover is 49%), with a few patches of bare soil, and a minute amount of cryptogram growth. Most of the sites are found on substrates of either the Goat Seep or Carlsbad Limestone Formations, with one site occurring on younger alluvial deposits.

Soils are mapped as Lazarus loam, 2 to 9% slopes (LAD) which are fine-silty, mixed, superactive, mesic Pachic Argiustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description
This herbaceous association is a luxuriant grassland codominated by *Nassella tenuissima* and *Bouteloua gracilis*, almost to the exclusion of other species (Table C200). The remaining eight recorded grass species occur irregularly, and are poorly represented or scattered (*Bouteloua curtipendula* is well represented where present). Total forb cover ranges from 0 to 6%, and is composed of a variety of 23 generally scattered species. The most frequently included is *Glandularia bipinnatifida* var. *bipinnatifida*; occasionally *Iva dealbata*, and globe mallows (*Sphaeralcea* spp.) can exceed 1% cover. Woody species are usually poorly represented (occasionally absent). The most common are the subshrub *Gutierrezia sarothrae*, shrub *Cylindropuntia imbricata*, and paddle cactus *Opuntia phaeacantha*. Trees occur rarely, represented by *Juniperus monosperma* or *Juniperus deppeana*.

Table C200. Most Abundant Species

Stratum	Species
Herb	*Nassella tenuissima, Bouteloua gracilis*

Other Noteworthy Species
*Marrubium vulgar*e is an introduced perennial forb species and infrequent, scattered associate.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ005, 07CJ011, 07CJ012, 07PA006, 07PA011.
Local Description Authors: H. Varani

***Nolina (texana, microcarpa) / Bouteloua eriopoda* Shrub Grassland**
Texas Sacahuista - Sacahuista / Black Grama Shrub Grassland (Table C201)

Identifier: CEPP006932

Table C201. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Nolina (texana, microcarpa) / Bouteloua eriopoda* Shrub Grassland

Distribution
This infrequent association is known to occur in the Bajadas area (southeast of El Capitan Peak) of Guadalupe Mountains NP.

Environmental Description
This association occurs at 4,557 ft (1,389 m) on a west facing alluvial slope with a very gentle gradient. Ground surface at the site features 47% gravel cover, and 10% cryptogram growth. The geologic substrates are younger alluvial deposits.

The soil is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which is a loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcid or fine-loamy, mixed, superactive, thermic Ustic Haplocalcid respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
Grass cover approaches 20% at this shrub herbaceous vegetation association site, the four recorded bunchgrass species are dominated by *Bouteloua curtipendula*, with *Bouteloua eriopoda* well represented (Table C202) and a presence of *Aristida divaricata*. Forbs do not occur at this site. Shrub cover approaches 15%, and is dominated by *Nolina texana* regularly dispersed throughout, and includes *Larrea tridentata*, and *Yucca elata*. Found among these are *Agave lechuguilla* and *Krameria grayi*.

Table C202. Most Abundant Species

Stratum	Species
Shrub	*Nolina texana*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 10TN032.
Local Description Authors: H. Varani

***Nolina (texana, microcarpa) / Muhlenbergia emersleyi* Shrub Grassland**
Texas Sacahuista - Sacahuista / Bullgrass Shrub Grassland (Table C203)

Identifier: CEPP006933

Table C203. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Nolina (texana, microcarpa) / Muhlenbergia emersleyi* Shrub Grassland

Distribution
This infrequent association occurs in West Dog Canyon of Basin and Range area of Guadalupe Mountains NP.

Environmental Description
This association is recorded at 6,450 ft (1,966 m) and occurs on a steep, west facing, colluvial slope. The site is rocky and gravelly in the vegetated interspaces. Geologic substrates are of the Carlsbad Limestone.

Soil at the site is mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH), which are loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrub herbaceous vegetation association features graminoid cover of 50%. Eight graminoid species are included, the dominant *Muhlenbergia emersleyi* is abundant (Table C204); *Bouteloua curtipendula* and *Eragrostis intermedia* are well represented. The dozen forb species that are generally scattered include *Chaetopappa ericoides*, *Erigeron flagellaris*, *Eriogonum hieraciifolium*, and *Linum vernale* as examples, with *Artemisia ludoviciana* present in excess of 1%. Shrubs and subshrubs reach 10% cover, represented by equal cover of diagnostic species, *Nolina texana* and *Cercocarpus montanus* var. *paucidentatus* as well as five other scattered species. Trees do not occur at this site.

Table C204. Most Abundant Species

Stratum	Species
Shrub	*Nolina texana*
Herb	*Muhlenbergia emersleyi*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ017.
Local Description Authors: H. Varani

***Nolina (texana, microcarpa) / Muhlenbergia setifolia* Shrub Grassland**
Texas Sacahuista - Sacahuista / Curlyleaf Muhly Shrub Grassland (Table C205)

Identifier: CEPP006934

Table C205. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Nolina (texana, microcarpa) / Muhlenbergia setifolia* Shrub Grassland

Distribution
This association is common on the slopes east of the Eastern Escarpment (on either side of the mouth of Pine Springs Canyon) with one site occurring in the Basin and Range area of Guadalupe Mountains NP.

Environmental Description
This association occurs at elevations of 5,696 to 6,444 ft (1,736 to 1,964 m) on gentle to steep slopes with east or southeastern aspects. Sites are rocky and gravelly in the vegetated interspaces. Geologic substrates include older and younger alluvial deposits, and the Goat Seep Limestone and Cherry Canyon Formation.

Soils are primarily mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) with minor soil units including Biduya-Desario-Rock outcrop complex, 10 to 50% slopes (BDG) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls and Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls) and Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This open shrub herbaceous vegetation association is diverse (with nearly 95 associates recorded) and features very abundant to luxuriant graminoid cover of a variety of 23 recorded species. *Muhlenbergia setifolia* is dominant (Table C206), consistently appearing alongside less than 5% cover of *Eragrostis intermedia*, often including *Bouteloua curtipendula* as well. At one site *Achnatherum lobatum* is very abundant. Forb may be absent or cover as much as 10%. *Viguiera dentata*, *Eriogonum hieraciifolium*, *Melampodium leucanthum*, and *Paronychia jamesii* are the most common of the 38 variable and scattered species. Shrubs are abundant (reaching 30% cover at one site); *Nolina texana* is most often the dominant, sometimes subdominant to *Viguiera stenoloba* (also common) and usually appearing alongside *Dasylirion leiophyllum* and *Quercus* × *pauciloba*. Subshrubs and cacti may reach 10% cover, likely represented by *Opuntia phaeacantha* and including *Parthenium incanum*, *Gutierrezia sarothrae*, and *Agave parryi* ssp. *neomexicana*. Trees are rare in this association, represented by *Juniperus deppeana*, *Juniperus monosperma*, *Pinus edulis*, *Juniperus pinchotii,* and *Quercus grisea*. The latter two species may also occur as part of the shrub layer.

Table C206. Most Abundant Species

Stratum	Species
Shrub	*Nolina texana*
Herb	*Muhlenbergia setifolia*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC197, 07CJ024, 07PA004, 07YC015, 07YC019.
Local Description Authors: H. Varani

***Parthenium incanum / Bouteloua eriopoda* Shrub Grassland**

Mariola / Black Grama Shrub Grassland (Table C207)

Identifier: CEGL001734

Table C207. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Parthenium incanum / Bouteloua eriopoda* Shrub Grassland

Distribution
This common association is scattered widely in Guadalupe Mountains NP, occurring in the Western Escarpment area west of Cutoff Ridge, and also South of El Capitan Peak, and in the Guadalupe Pass area near the mouth of Pine Spring Canyon.

Environmental Description
This association occurs at elevations from 4,692 to 5,981 ft (1,430 to 1,823 m), generally on steep slopes with variable aspects. Sites are rocky and gravely, with small patches of litter, exposed soil, and cryptogrammic crusts in the vegetated interspaces. Geologic substrates include the Cherry Canyon Formation and Victorio Peak gray member of the Bone Spring Limestone.

Soils are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) (loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids) and Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This open shrub herbaceous vegetation association is diverse (with 93 associates) and has variable characteristics. Most commonly, grasses are very abundant and dominated by *Bouteloua eriopoda* (Table C208). The 25 other graminoid species most frequently include *Bouteloua gracilis* (sometimes codominant), *Bouteloua curtipendula*, *Achnatherum eminens*, and *Leptochloa dubia*. Forbs are generally poorly represented but reach 20% total cover at one site (composed mostly of *Astrolepis cochisensis*), and include 23 variable species. *Thymophylla pentachaeta*, *Paronychia jamesii*, and *Bahia absinthifolia* are a few examples. Subshrubs are consistently abundant, the 21 species dominated by *Parthenium incanum*, and usually including *Opuntia phaeacantha*, and *Gutierrezia sarothrae*. Shrub cover is less than 15% generally, with an atypical site reaching 50%. Of the 23 recorded species, *Viguiera stenoloba* and *Aloysia wrightii* are consistently included and can be abundant. *Dasylirion leiophyllum* and *Yucca torreyi* are common and occasionally, *Leucophyllum minus* or *Opuntia engelmannii* can be well represented. No trees occur in this association.

Table C208. Most Abundant Species

Stratum	Species
Subshrub	*Parthenium incanum*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ041, 07CJ045, 07CJ056, 07YC041, 10TN011.
Local Description Authors: H. Varani

Setaria leucopila / Solanum elaeagnifolium Grassland

Streambed Bristlegrass / Silverleaf Nightshade Grassland (Table C209)

Identifier: CEPP007484

Table C209. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Setaria leucopila / Solanum elaeagnifolium* Grassland

Distribution

This infrequent association occurs in the Bajadas area (east of the Patterson Hills) and Eastern Alluvial Uplands area (near the mouth of Pine Spring Canyon) of Guadalupe Mountains NP.

Environmental Description

This association is known to occur in the elevations ranging from 4,469 to 5,751 ft (1,362 to 1,753 m) on gentle slopes of variable aspects, or on flat locations. Sites may feature patches of exposed soils or litter cover among the vegetation. Geologic substrates included older and younger alluvial deposits, and the Cherry Canyon Formation.

Soils are mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series), McKittrick-Riverwash complex soils, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls) and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This association may have ruderal characteristics and include many annual species. Forbs are important in this herbaceous association and may reach 30% cover. Characterized by abundant *Solanum elaeagnifolium* (Table C210), *Verbesina encelioides* may also be abundant among the nine other species. Sites feature 20 to 60% grass cover, which may be dominated by either *Setaria leucopila* or *Sporobolus cryptandrus*. Shrubs are not present at every site, and may be represented by *Atriplex canescens*, *Cylindropuntia imbricata*, *Larrea tridentata* or the subshrub *Gutierrezia sarothrae*. Trees do not occur in this association.

Table C210. Most Abundant Species

Stratum	Species
Herb	*Setaria leucopila, Solanum elaeagnifolium*

Other Noteworthy Species

Euphorbia davidii an annual, and *Marrubium vulgar*e, a perennial, are two introduced forbs found scattered at one site in this association. *Eragrostis cilianensis* is an annual introduced grass found poorly represented at one site.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC255, 08GM015, 08SS021.
Local Description Authors: H. Varani

Viguiera stenoloba / Bouteloua curtipendula Shrub Grassland

Skeletonleaf Goldeneye / Sideoats Grama Shrub Grassland (Table C211)

Identifier: CEPP007492

Table C211. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Viguiera stenoloba / Bouteloua curtipendula* Shrub Grassland

Distribution

This infrequent association can be found in the Western Escarpment area (west of PX flat), and in the Pine Spring Canyon area (near the canyon mouth) of Guadalupe Mountains NP.

Environmental Description

This association occurs in the elevation range of 4,554 to 6,368 ft (1,388 to 1,941 m) on moderate to steep slopes, with southerly and westerly aspects. Sites feature many boulders or are gravelly, with some exposed soils. Geologic substrates are of Victorio Peak gray member of the Bone Spring Limestone, and the Hegler limestone member of the Bell Canyon Formation.

Soils are mapped as Bissett-Rock outcrop complex, 15 to 60% slopes (BRG) (loamy-skeletal, mixed, superactive, thermic Lithic Ustic Haplocalcids) and Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrub herbaceous association features abundant to luxuriant shrub canopies (30-50% cover) where *Viguiera stenoloba* is abundant (Table C212), *Dasylirion leiophyllum* can be well represented, *Opuntia engelmannii* is included and 18 other species may occur. Subshrubs may reach 20% cover, including *Parthenium incanum* consistently of the nine species. Grasses can reach 40% cover in the understory, the 21 species are dominated by *Bouteloua curtipendula*, with *Bouteloua gracilis*, and *Leptochloa dubia* present; *Hesperostipa neomexicana* is well represented at one site. Of the 16 forb species, only *Artemisia ludoviciana* exceeds 1% cover where it occurs, the group covers an average total of 4%. No trees occur in this association.

Table C212. Most Abundant Species

Stratum	Species
Shrub	*Viguiera stenoloba*
Herb	*Bouteloua curtipendula*

Other Noteworthy Species

Eragrostis lehmanniana is an introduced perennial grass found poorly represented at one site in this association.

Euphorbia davidii is an introduced annual forb species found scattered at one site.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ059, 07YC030.
Local Description Authors: H. Varani

***Viguiera stenoloba / Bouteloua eriopoda* Shrub Grassland**
Skeletonleaf Goldeneye / Black Grama Shrub Grassland (Table C213)

Identifier: CEPP007501

Table C213. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Viguiera stenoloba / Bouteloua eriopoda* Shrub Grassland

Distribution
This infrequent association occurs west of Blue Ridge in the Western Escarpment area of Guadalupe Mountains NP.

Environmental Description
This association occurs at the elevations of 4,633 and 4,695 ft (1,412 and 1,450 m) on gentle slopes of western aspect. Sites are rocky or gravelly, and average 5% cover of cryptogrammic crust. Geologic substrates are of younger alluvial deposits.

Soils are mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal (or fine loamy), mixed, superactive, thermic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrub herbaceous association is primarily composed of grasses (averaging 55% cover), the 15 species including abundant cover of *Bouteloua eriopoda* (Table C214; though potentially dominated by *Bouteloua gracilis*), and including *Muhlenbergia porteri*, *Lycurus setosus*, *Sporobolus cryptandrus*, and *Panicum hallii*. Forbs are poorly represented in the herbaceous layer, including *Thymophylla pentachaeta*, *Astrolepis cochisensis*, and *Verbena perennis*. Shrubs cover exceeds 20% and features abundant cover of *Viguiera stenoloba*, and includes *Dasylirion leiophyllum*, *Yucca torreyi*, and *Fouquieria splendens* and some combination of the eight other species. Of the eight subshrubs, *Opuntia phaeacantha*, and *Echinocereus dasyacanthus* occur at both sites, and *Parthenium incanum* is well represented at one site, though absent at the other. Trees do not occur in this association.

Table C214. Most Abundant Species

Stratum	Species
Shrub	*Viguiera stenoloba*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ062, 07CJ063.
Local Description Authors: H. Varani

***Viguiera stenoloba / Muhlenbergia pauciflora* Shrub Grassland**
Skeletonleaf Goldeneye / New Mexico Muhly Shrub Grassland (Table C215)

Identifier: CEPP007506

Table C215. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Viguiera stenoloba / Muhlenbergia pauciflora* Shrub Grassland

Distribution
This infrequent association is known to occur in the Mountain High Country (in West Dog Canyon and east of Blue Ridge) and in the Eastern Escarpment and Pine Spring Canyon areas (near the mouth of Pine Spring Canyon) of Guadalupe Mountains NP.

Environmental Description
This association can be found locally at elevations from 6,349 to 8,189 ft (1,935 to 2,496 m) on moderately steep to very steep slopes of south and east facing aspects. Sites are rocky and gravelly in the vegetated interspaces. Geologic substrates are of the Carlsbad Limestone and the Bell Canyon Formation (including the Pinery limestone member).

Soils are mapped as Lostpeak-Rock outcrop complex, 40 to 95% slopes (LRH) (loamy-skeletal, mixed, superactive, mesic Aridic Lithic Haplustolls), Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), and Victorio-Lozen-Rock outcrop complex, 10 to 60% slopes (VLG) (clayey-skeletal, mixed, superactive, mesic Lithic Argiustolls and loamy-skeletal, mixed, superactive, mesic Lithic Haplustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description
In this shrub herbaceous association, the herbaceous understory is abundant to luxuriant and consistently dominated by *Muhlenbergia pauciflora* (Table C216), including *Eragrostis intermedia* and commonly *Achnatherum lobatum*, and *Muhlenbergia emersleyi*. Not as common, *Muhlenbergia dubia* is abundant at one of the sites where it occurs; the 13 other species vary. Forbs are a minor component (not exceeding 5% total cover) and are diverse and variable. Of the 28 forb species *Eriogonum hieraciifolium* occurs the most frequently; *Viguiera dentata* and *Tragia ramosa* are common. Shrub cover averages just over 30%; *Viguiera stenoloba* is commonly well represented, alongside lesser covers of *Cercocarpus montanus* var. *paucidentatus* and *Dasylirion leiophyllum*. The 13 other species vary, and are generally scattered, though at one site *Rosa stellata* exceeds 40% cover. Subshrubs can be absent or abundant and most commonly include *Chrysactinia mexicana*, *Agave parryi* ssp. *neomexicana*, and *Parthenium incanum*. Trees (occurring at one site) are well represented by *Juniperus deppeana*, and scattered *Pinus edulis*.

Table C216. Most Abundant Species

Stratum	Species
Shrub	*Viguiera stenoloba*
Herb	*Muhlenbergia pauciflora*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC213, 07CJ009, 07CJ035, 08CJ031.
Local Description Authors: H. Varani

***Viguiera stenoloba / Bouteloua gracilis* Shrub Grassland**
Skeletonleaf Goldeneye / Blue Grama Shrub Grassland (Table C217)

Identifier: CEPP007516

Table C217. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Viguiera stenoloba / Bouteloua gracilis* Shrub Grassland

Distribution
This infrequent association occurs at the base of the Eastern Escarpment between Manzanita Spring and Upper Pine Spring in Guadalupe Mountains NP.

Environmental Description
This association is found at the elevations of 5,832 and 6,145 ft (1,778 and 1,873 m) on moderate to steep, southeasterly slopes. Sites are gravelly with scattered rocks and patches of cryptogram growth (averaging 4% cover) among the vegetation. Geologic substrates are of the Cherry Canyon Formation and Pinery limestone member of the Bell Canyon Formations.

Soils are mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), which are very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrub herbaceous association is characterized by luxuriant grass cover dominated by *Bouteloua gracilis* (Table C218) and including *Eragrostis intermedia*. At one site or the other *Lycurus setosus* and *Muhlenbergia dubia* are abundant or well represented respectively. Forbs are absent at one site, yet reaching nearly 10% cover at the other, including only *Erigeron flagellaris* and croton (*Croton* spp.). The combination of shrubs and subshrub ranges from 20 to 40% cover. Of the seven shrub species, *Viguiera stenoloba* is well represented and occurs alongside *Yucca elata*, and *Aloysia wrightii*. The subshrubs include four species, *Parthenium incanum* is well represented alongside individuals of *Opuntia phaeacantha*. Trees do not occur at these sites, but may be represented by *Juniperus pinchotii*.

Table C218. Most Abundant Species

Stratum	Species
Shrub	*Viguiera stenoloba*
Herb	*Bouteloua gracilis*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08CJ026, 08CJ028.
Local Description Authors: H. Varani

***Yucca torreyi / Bouteloua eriopoda* Shrub Grassland**
Torrey's Yucca / Black Grama Shrub Grassland (Table C219)

Identifier: CEPP007523

Table C219. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland Group [G490]
Association	*Yucca torreyi / Bouteloua eriopoda* Shrub Grassland

Distribution
This infrequent association is known to occur east of Crow Flats in the Bajadas area of Guadalupe Mountains NP.

Environmental Description
This association is recorded at an elevation of 3,825 ft (1,166 m) on an upper bajada with very little slope and western aspect. The site is rocky with some gravel and exposed soil as well as 15% cryptogram cover and overlays younger alluvial deposits.

Soil at the site is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD), made up of loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
Vegetation at this site is very open. Grass cover reaches 20%, dominance shared between *Bouteloua eriopoda*, and *Sporobolus cryptandrus*, well represented among the nine species (Table C220). Seven forbs are recorded and cover 10%, predominantly consisting of *Thymophylla pentachaeta*, and including *Allionia incarnate*, and *Bahia absinthifolia* as well. Seven fairly dispersed shrubs reach 10% cover, *Cylindropuntia leptocaulis*, *Fouquieria splendens*, *Larrea tridentata*, *Prosopis glandulosa* and *Yucca torreyi* are all poorly represented. Subshrubs are well represented, consisting mostly of *Krameria grayi*, and *Opuntia phaeacantha* among five other species. Trees do not occur in this association.

Table C220. Most Abundant Species

Stratum	Species
Shrub	*Yucca torreyi*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species

Eragrostis lehmanniana is an introduced perennial grass found poorly represented at this site.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC048.
Local Description Authors: H. Varani

G492 Chihuahuan Gypsophilous Grassland Group

***Ephedra torreyana / Bouteloua breviseta* Dwarf-shrub Grassland**
Torrey's Jointfir / Gyp Grama Dwarf-shrub Grassland (Table C221)

Identifier: CEPP007425

Table C221. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Ephedra torreyana / Bouteloua breviseta* Dwarf-shrub Grassland

Distribution

This infrequent association is known to occur in the Sand Dunes area of Guadalupe Mountains NP, near the western most park boundary.

Environmental Description

This association is recorded in the elevations ranging from 3,642 to 3,678 ft (1,110 to 1,121 m). Sites are not sloped, and ground cover reaches nearly 35% soil exposure, and 30% cryptogrammic crust cover. Geologic substrates are younger alluvial deposits.

Soils are mapped primarily as Monahans-Pajarito complex, 0 to 5% slopes (MPB), which are made up of coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series. One site is located on soil classified as Corvus-Peligro complex, one to 5% slopes (CPB) which consists of loamy, hypergypsic, thermic, shallow Typic Petrogypsids or coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description

This variable herbaceous/dwarf shrub association features grass cover that averages 30%, and is dominated by *Bouteloua breviseta* (Table C222), often alongside abundant cover of *Sporobolus flexuosus*. Forb cover ranges from nearly absent to as much as 25% with 17 species varying from site to site (including *Sartwellia flaveriae*, *Mentzelia*

humilis var. *guadalupensis*, and *Gaillardia multiceps*). Dwarf shrubs (covering an average of 2%) include the nominal *Ephedra torreyana* alongside *Tiquilia hispidissima* and/or *Krameria grayi*. *Ephedra torreyana* is also consistently present among the poorly represented shrubs, while *Prosopis glandulosa* and *Yucca elata* are common but not abundant. No trees occur in this association.

Table C222. Most Abundant Species

Stratum	Species
Shrub	*Ephedra torreyana*
Herb	*Bouteloua breviseta*

Other Noteworthy Species

Mentzelia humilis var. *guadalupensis* is recognized in New Mexico as a rare plant. It is known to occur on open gypsum outcrops in southeastern Otero County, New Mexico, and the west slope of the Guadalupe Mountains, Texas. In this association it is common, and can be well represented.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC077, 07YC078, 07YC079, 10TN027.
Local Description Authors: H. Varani

***Sporobolus nealleyi - Sporobolus airoides* Grassland**

Gyp Dropseed - Alkali Sacaton Grassland (Table C223)

Identifier: CEPP007465

Table C223. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Sporobolus nealleyi - Sporobolus airoides* Grassland

Distribution

This common association can be found in the Sand Dunes area near the westernmost boundary of Guadalupe Mountains NP.

Environmental Description

This association is found in the lower elevations of this park, ranging from 3,622 to 3,633 ft (1,104 to 1,112 m). Sites are not sloped, lack rocks, and are found on gypseous soils. Ground surfaces are 50% exposed, revealing soil or cryptogrammic crusts (as much as 40% cryptogram cover). Geologic substrates are of younger alluvial deposits in salt basins often forming gypsum soils.

Soils are mapped as and Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

Grass cover of this herbaceous association ranges from 2% to 50%, and is dominated by *Sporobolus airoides*, and includes *Sporobolus nealleyi* (Table C224). Only two other grass species are recorded, *Muhlenbergia porteri* and *Bouteloua breviseta*. Eight forb species contribute a minor amount to herbaceous cover; most are scattered though cover of *Sartwellia flaveriae* generally exceeds 1%. Shrubs, subshrubs, and cacti occur often though the combination rarely exceeds 10% total cover and most often includes *Atriplex canescens*. Other examples of the 14 recorded species include the shrubs *Ephedra torreyana* and *Cylindropuntia imbricata*, the subshrubs *Isocoma pluriflora*, and *Tiquilia hispidissima*, and the paddle cacti *Opuntia phaeacantha* and *Opuntia polyacantha*. No trees occur in this association.

Table C224. Most Abundant Species

Stratum	Species
Herb	*Sporobolus airoides, Sporobolus nealleyi*

Other Noteworthy Species

Salsola tragus is an introduced annual forb species and infrequent associate.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC060, 07YC062, 07YC069, 10TN015, 10TN022.
Local Description Authors: H. Varani

***Tiquilia hispidissima / Bouteloua breviseta - Sporobolus nealleyi* Shrub Grassland**

Hairy Crinklemat / Gyp Grama - Gyp Dropseed Shrub Grassland (Table C225)

Identifier: CEPP007487

Table C225. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Tiquilia hispidissima / Bouteloua breviseta - Sporobolus nealleyi* Shrub Grassland

Distribution

This infrequent association is known to occur in the gypseous Sand Dunes area near the westernmost boundary of Guadalupe Mountains NP.

Environmental Description

This association occurs on gypsum soils in lower elevations of the park, ranging from 3,629 to 3,638 ft (1,106 to 1,112 m). Sites are flat to gently sloping (<10%) and ground surfaces at all sites feature 50% cover of cryptogrammic soil crusts with 30 to 40% cover of exposed soil. Sites are and interdune plain with a very patterned surface of small hillocks. Geologic substrates are of younger alluvial deposits often forming gypsum soils.

Soils are mapped as Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) and

as Lark-Peligro complex, one to 8% slopes (LPC) which are gypsic, thermic Typic Torripsamments or coarse gypseous, hypergypsic, thermic Leptic Haplogypsids relative to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
This open shrubland association features an average of 9% dwarf-shrub cover, represented mainly by *Tiquilia hispidissima* (Table C226). Other shrubs are poorly represented, and may include *Ephedra torreyana*, and *Cylindropuntia leptocaulis*. In the herbaceous layer, grass cover rivals dwarf-shrub cover and is dominated by *Bouteloua breviseta* and includes *Sporobolus nealleyi* or occasionally *Sporobolus flexuosus*, and/or *Muhlenbergia porteri*. Forbs are generally scattered, most often including *Sartwellia flaveriae*, and *Selinocarpus lanceolatus*. Trees do not occur in this association.

Table C226. Most Abundant Species

Stratum	Species
Subshrub	*Tiquilia hispidissima*
Herb	*Bouteloua breviseta, Sporobolus nealleyi*

Other Noteworthy Species
Mentzelia humilis var. *guadalupensis* is recognized in New Mexico as a rare plant. It is known to occur on open gypsum outcrops in southeastern Otero County, New Mexico, and the west slope of the Guadalupe Mountains, Texas. It is commonly scattered in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC064, 07YC066, 07YC076.
Local Description Authors: H. Varani

***Tiquilia hispidissima / Dasyochloa pulchella* Dwarf-shrub Grassland**
Hairy Crinklemat / Fluffgrass Dwarf-shrub Grassland (Table C227)

Identifier: CEPP007490

Table C227. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Tiquilia hispidissima / Dasyochloa pulchella* Dwarf-shrub Grassland

Distribution
This uncommon association type occurs in a small half-hectare area with fine-grained soil in an upper bajada area of Guadalupe Mountains NP near PX Well site.

Environmental Description
The association occurs in the elevations ranging from of 3,806 ft (1,160 m) on gypsum outcrops. The single site is gently sloped and features 36% cryptogrammic crust cover and 30% exposed soil cover. Geologic substrates are younger alluvial deposits.

Soils are mapped as Chilicotal-Chispa complex, 3 to 13 percent (CCD) either Chilicotal (Loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids) or Chispa (Fine-loamy, mixed, superactive, thermic Ustic Haplocalcids) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This dwarf-shrub herbaceous association has an open woody component and moderate herbaceous understory. Subshrub cover is 3 to 5% cover and almost entirely consisting of *Tiquilia hispidissima* (Table C228), with low cover of several species such as *Echinocereus stramineus*, *Krameria grayi*, *Opuntia phaeacantha*, and *Thymophylla acerosa*, and scattered taller shrubs *Larrea tridentata* and *Yucca elata*. Herbaceous layer has 20% grass cover and is dominated by *Dasyochloa pulchella* with *Aristida divaricata*, *Muhlenbergia porteri*, and *Setaria leucopila* present. Forbs are poorly represented, the seven recorded species are all scattered with *Thymophylla acerosa* common.

Table C228. Most Abundant Species

Stratum	Species
Subshrub	*Tiquilia hispidissima*
Herb	*Dasyochloa pulchella*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ054.
Local Description Authors: K.A. Schulz

***Tiquilia hispidissima / Sartwellia flaveriae* Dwarf-shrubland**
Hairy Crinklemat / Threadleaf Glowwort Dwarf-shrubland (Table C229)

Identifier: CEPP007491

Table C229. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Tiquilia hispidissima / Sartwellia flaveriae* Dwarf-shrubland

Distribution
This infrequent association is known to occur in the gypseous sand dunes near the westernmost boundary of Guadalupe Mountains NP.

Environmental Description
This association can be found in the elevation range of 3,645 to 3,652 ft (1,111 to 1,113 m) on gypseous sands. Sites are not sloped, and vegetated interspaces consist of a combination of cryptogrammic soil crusts (40% average cover), exposed sand (26% average cover), and litter (12% average cover). Geologic substrates are of younger alluvial deposits often forming gypsum soils.

Soils are mapped as Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This dwarf-shrubland association is characterized by abundant cover of *Tiquilia hispidissima* (Table C230); *Opuntia polyacantha* is consistently present as well, and can be very abundant. Shrubs are generally poorly represented, but can reach 10% cover and consistently include *Cylindropuntia leptocaulis* and *Ephedra torreyana*. Forb cover ranges from 7% to as much as 30%, and generally dominates the herbaceous layer, consisting almost entirely of *Sartwellia flaveriae*, and including *Lepidium alyssoides* var. *angustifolium*. The remaining six forb species are variable and scattered. Grass cover can occasionally reach 7%, but of the six poorly represented or scattered species, only *Sporobolus nealleyi* is common, *Bouteloua breviseta*, *Muhlenbergia porteri*, *Sporobolus cryptandrus*, *Sporobolus flexuosus*, and *Sporobolus contractus* all occur at one site or another. Trees do not occur in this association.

Table C230. Most Abundant Species

Stratum	Species
Subshrub	*Tiquilia hispidissima*
Herb	*Sartwellia flaveriae*

Other Noteworthy Species

Mentzelia humilis var. *guadalupensis* is recognized in New Mexico as a rare plant. It is known to occur on open gypsum outcrops in southeastern Otero County, New Mexico, and the west slope of the Guadalupe Mountains, Texas. In this association it is commonly scattered.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07YC073, 07YC074, 07YC075.
Local Description Authors: H. Varani

***Tiquilia hispidissima / Sporobolus nealleyi* Dwarf-shrubland**

Hairy Crinklemat / Gyp Dropseed Dwarf-shrubland (Table C231)

Identifier: CEGL001546

Table C231. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Gypsophilous Grassland Group [G492]
Association	*Tiquilia hispidissima / Sporobolus nealleyi* Dwarf-shrubland

Distribution

This common association type occurs in the Sand Dunes area of Guadalupe Mountains NP, near the westernmost park boundary.

Environmental Description

The association occurs in the elevations ranging from of 3,622 to 3,669 ft (1,104 to 1,118 m) on gypsum outcrops. Sites are flat or very gently sloped and feature an average of 68% cryptogrammic crust cover, and an average of 15% exposed soil cover. Geologic substrates are younger alluvial deposits.

Soils are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) and Corvus-Peligro complex, 1 to 5% slopes (CPB) (loamy, hypergypsic, thermic, shallow Typic Petrogypsids and coarse-gypseous, hypergypsic, thermic Leptic Haplogypsids respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This dwarf-shrub herbaceous association is fairly split between the open woody component and the sparse herbaceous understories. Subshrub cover averages 10% (ranging from 3% to 19% cover), almost entirely consisting of *Tiquilia hispidissima* (Table C232), but often including various pricklypears (*Opuntia polyacantha*, *Opuntia phaeacantha*, and *Opuntia macrocentra*). Taller shrubs may be absent, averaging just over 1% cover and including *Atriplex canescens* most often. Herbaceous layers average 9% grass cover, (ranging from 3% to 15%) and usually consists entirely of *Sporobolus nealleyi*, sometimes including *Sporobolus airoides* and/or *Muhlenbergia porteri*. Forbs are poorly represented, the seven recorded species are all scattered, including *Sartwellia flaveriae* and *Selinocarpus lanceolatus* most often. Trees do not occur in this association.

Table C232. Most Abundant Species

Stratum	Species
Subshrub	*Tiquilia hispidissima*
Herb	*Sporobolus nealleyi*

Other Noteworthy Species

Data are not available

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ066, 07YC054, 07YC055, 07YC058, 07YC068, 10TN016, 10TN019.
Local Description Authors: H. Varani

G491 Chihuahuan Sandy Plains Semi-Desert Grassland Group

NVC Description: This dry grassland group occurs on sandy sites across the Chihuahuan Desert with the graminoid layer typically dominated or codominated by *Bouteloua eriopoda* and *Sporobolus flexuosus*. Other common species are *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana* (minor), *Muhlenbergia arenicola*, *Sporobolus airoides*, *Sporobolus contractus*, and *Sporobolus cryptandrus*. Typically, there are scattered desert shrubs and stem succulents present, such as *Ephedra torreyana*, *Ephedra trifurca*, *Opuntia phaeacantha*, *Yucca elata*, and *Yucca torreyi*, that may form a layer. The widespread shrub *Artemisia filifolia* is also present in some stands, especially in the northern extent. Stands occur across the Chihuahuan Desert where soils have a high sand content such as on sandy plains and on sandy mesatops. They are often associated with alluvial or eolian deposits and sandstone substrates.

Yucca elata / Bouteloua eriopoda - Bouteloua gracilis Shrub Grassland

Soaptree Yucca / Black Grama - Blue Grama Shrub Grassland (Table C233)

Identifier: CEPP007518

Table C233. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Sandy Plains Semi-Desert Grassland Group [G491]
Association	*Yucca elata / Bouteloua eriopoda - Bouteloua gracilis* Shrub Grassland

Distribution

This infrequent association occurs on the foot-slopes of the Eastern Escarpment, in the Guadalupe Pass area of Guadalupe Mountains NP.

Environmental Description

This association occurs at the elevations of 5,541 and 5,787 ft (1,689 and 1,764 m) on alluvial fans and inset fans with gentle slopes. Sites feature dense herbaceous cover with little exposed soil and only a small amount of limestone gravel. Geologic substrates are older alluvial deposits.

Soils are mapped as Pinery, Choza, and Altuda, 5 to 60% slopes (PCG), very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description

This diverse shrub herbaceous association features *Yucca elata* dotted into a luxuriant grassland that averages 75% cover and includes 18 grass species and 39 forbs (Table C234). These are dominated by *Bouteloua eriopoda* and subdominated by *Bouteloua gracilis*, but commonly include *Aristida purpurea* var. *wrightii*, *Bothriochloa barbinodis*, *Elymus elymoides*, and *Lycurus setosus*. Forb cover reaches 10%, including 39 species of which *Glandularia bipinnatifida*, *Melampodium leucanthum*, *Solanum elaeagnifolium*, and *Aphanostephus ramosissimus* are scattered but common. At one site or the other *Calylophus hartwegii* ssp. *pubescens* and/or *Chamaesyce glyptosperma* are well represented; the remaining forb species are poorly represented or scattered. Other shrubs occur but don't exceed 1%, most commonly of the six species are *Baccharis pteronioides*, and *Cylindropuntia imbricata*. Subshrubs and cacti are also poorly represented at site, including six species, most commonly *Gutierrezia sarothrae*, and *Opuntia phaeacantha*. Canopy trees are not recorded at the sites (though saplings of *Juniperus pinchotii* are recorded at one site) but *Juniperus monosperma* occurs nearby.

Table C234. Most Abundant Species

Stratum	Species
Shrub	*Yucca elata*
Herb	*Bouteloua eriopoda, Bouteloua gracilis*

Other Noteworthy Species

Salsola tragus and *Euphorbia davidii*, annual forb species, and *Convolvulus arvensis*, a perennial forb species, are all introduced species recorded scattered at one site or the other in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC196, 07YC047.
Local Description Authors: H. Varani

***Yucca elata / Bouteloua eriopoda* Shrub Grassland**

Soaptree Yucca / Black Grama Shrub Grassland (Table C235)

Identifier: CEGL001735

Table C235. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Sandy Plains Semi-Desert Grassland Group [G491]
Association	*Yucca elata / Bouteloua eriopoda* Shrub Grassland

Distribution

This infrequent association is found in the Bajadas (south of El Capitan Peak), Eastern Alluvial Uplands (on the foothills of the Eastern Escarpment), and Pine Spring Canyon areas (near the mouth) of Guadalupe Mountains NP.

Environmental Description

This association can be found in the elevations ranging from 4,423 to 5,912 ft (1,348 to 1,802 m) on gentle to moderate, southerly slopes. Sites are gravelly, with a small amount of exposed soil and larger rock; cryptogram growth is sparse. The association can occur in post-burn areas. Geologic substrates are of older and younger alluvial deposits.

Soils are mapped as either Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series), or Pinery, Choza, and Altuda soils, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

In this association, shrubs are well-represented in a luxuriant grassland composed of a variety of 25 grass species. The dominant species, *Bouteloua eriopoda*, is well-represented to abundant (Table C236), occurring alongside *Setaria leucopila* or commonly *Bouteloua curtipendula*, and *Muhlenbergia porteri*. Forbs can be abundant in

the herbaceous layer, but are variable. *Chamaesyce serpyllifolia*, *Solanum elaeagnifolium*, *Thymophylla pentachaeta*, and *Tetraclea coulteri* are the most common of the 36 recorded species, and *Croton pottsii*, and *Sphaeralcea incana* are abundant where they occur. The shrub component of this shrubland association rarely exceeds 15% cover, with a variety of 16 recorded species. *Yucca elata* is always represented, *Prosopis glandulosa* is common, and *Larrea tridentata* is sometimes abundant. Cover of subshrubs and cacti ranges from 1% to 25% and consistently includes *Opuntia phaeacantha*, and though not as common, *Krameria grayi* and *Gutierrezia sarothrae* may be more conspicuous. Mature canopy trees are not recorded, but may be represented by *Juniperus deppeana*, *Juniperus monosperma*, or *Juniperus pinchotii*.

Table C236. Most Abundant Species

Stratum	Species
Shrub	*Yucca elata*
Herb	*Bouteloua eriopoda*

Other Noteworthy Species

Euphorbia davidii is an introduced annual forb species recorded scattered as an occasional associate.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC247, 06YC257, 07CJ027, 08GM032.
Local Description Authors: H. Varani

Yucca elata / Bouteloua gracilis Shrub Grassland

Soaptree Yucca / Blue Grama Shrub Grassland (Table C237)

Identifier: CEPP007520

Table C237. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Sandy Plains Semi-Desert Grassland Group [G491]
Association	*Yucca elata / Bouteloua gracilis* Shrub Grassland

Distribution

This infrequent association is known to occur on a foot-slope of Guadalupe Peak in the Guadalupe Pass area of Guadalupe Mountains NP.

Environmental Description

This association is recorded at 5,704 ft (1,739 m) on a gentle slope with a northeast aspect. The site features exposed soil and litter patches among the herbaceous vegetation, with no rock and little gravel. Geologic substrates are older alluvial deposits.

Soils are mapped as Pinery, Choza, and Altuda soils 5 to 60% slopes (PCG), which are very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be classified further respective to series as Lithic, shallow Petrocalci, or Aridic (USDA NRCS and USDI NPS 2010).

Vegetation Description

This grassland association is dominated by *Bouteloua gracilis* (Table C238). Eight other grasses are poorly represented at this site. The dwarf shrub *Gutierrezia sarothrae* is abundant, and occurs alongside *Opuntia phaeacantha* and *Dalea formosa*. Twenty-two forbs are found at this site and total 7% cover, though the only species that exceed 1% cover are *Berlandiera lyrata* and *Rhynchosia senna* var. *texana*. Shrubs are poorly represented and include five species (*Baccharis pteronioides*, *Cylindropuntia imbricata*, *Prosopis glandulosa*, *Rhus microphylla*, and *Yucca elata*). Trees do not occur at this site.

Table C238. Most Abundant Species

Stratum	Species
Subshrub	*Gutierrezia sarothrae*
Herb	*Bouteloua gracilis*

Other Noteworthy Species

Euphorbia davidii is an introduced annual species present at this site at the time of sampling.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM025.
Local Description Authors: H. Varani

G489 Chihuahuan Semi-Desert Lowland Grassland

***Bouteloua gracilis - Panicum obtusum* Grassland**

Blue Grama - Vine Mesquite Grassland (Table C239)

Identifier: CEPP006878

Table C239. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	Chihuahuan Semi-Desert Grassland (M087)
Group	Chihuahuan Semi-Desert Lowland Grassland [G489]
Association	*Bouteloua gracilis - Panicum obtusum* Grassland

Distribution

This infrequent association is found in the Basin and Range area (near West Dog Canyon) and near the mouth of Pine Spring Canyon in Guadalupe Mountains NP.

Environmental Description

This association occurs in the elevation range of 5,715 to 6,424 ft (1, 742 to 1,958 m) near drainages on gently slopes of variable aspect. Sites are densely vegetated with interspaces mostly featuring patches of exposed soil. Geologic substrates are of the Carlsbad Limestone, and older and younger alluvial deposits.

Soils are mapped as either Lazarus loam, 2 to 9% slopes (LAD) (fine-silty, mixed, superactive, mesic Pachic Argiustolls) or Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic) (USDA NRCS and USDI NPS 2010).

Vegetation Description

Grasses are luxuriant in this herbaceous association: *Bouteloua gracilis* is the dominant species, *Panicum obtusum* can be very abundant (Table C240), and *Bouteloua curtipendula* is generally well represented. The 15 other graminoids vary, each species rarely exceeding 3% cover. Forbs in the herbaceous layer may be absent or cover up to 6% total, most frequently including *Convolvulus equitans*, *Acourtia nana*, and *Schoenocrambe linearifolia*. Shrubs (9 species) and subshrubs (3 species) rarely exceed 10% cover combined, and include *Cylindropuntia imbricata* and *Gutierrezia sarothrae* consistently. Trees are commonly absent, where scarce they are represented by *Juniperus monosperma* and *Celtis laevigata* var. *reticulata*.

Table C240. Most Abundant Species

Stratum	Species
Herb	*Bouteloua gracilis, Panicum obtusum*

Other Noteworthy Species

*Marrubium vulgar*e is an introduced perennial forb species observed at one site in excess of 1% cover.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ004, 07PA016, 08GM029.
Local Description Authors: H. Varani

G541 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group

***Chilopsis linearis - Fallugia paradoxa* Desert Wash Shrubland**

Desert Willow - Apache Plume Desert Wash Shrubland (Table C241)

Identifier: CEPP006880

Table C241. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Chilopsis linearis - Fallugia paradoxa* Desert Wash Shrubland

Distribution

This infrequent association can be found in the Bajadas area, east of the Patterson Hills in Guadalupe Mountains NP.

Environmental Description
This association is known to occur at 4,508 ft (1,374 m) on an alluvial bar within a drainage. The site is nearly flat, and features substantial amounts of rock and gravel cover (25% gravel, 20% rock). Geologic substrates at the site are of younger alluvial deposits.

The soil is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series (USDA NRCS and USDI NPS 2010).

Vegetation Description
At the site, this open shrubland association features 30% shrub cover composed of 15 species dominated by abundant cover of *Chilopsis linearis* (Table C242). Here, *Viguiera stenoloba* is well represented, and while *Fallugia paradoxa* is poorly represented at this site, it is more abundant along the active channel. *Acacia neovernicosa*, and *Larrea tridentata* are also poorly represented. Seven subshrubs and cacti are scattered among the shrubs (*Gutierrezia sarothrae*, *Opuntia macrocentra*, *Parthenium incanum*, and *Echinocereus dasyacanthus* as examples). The 30% grass cover is composed of 11 species, and dominated by the annual grass *Bouteloua barbata*; *Bouteloua aristidoides*, *Bouteloua eriopoda*, *Setaria leucopila*, *Sporobolus contractus*¸ and *Sporobolus cryptandrus* are poorly represented among the remaining scattered grasses. Forbs include 11 species, the 5% total cover codominated by the annual *Chamaesyce serpyllifolia*, and the perennial *Commelina erecta*; the other species are scattered. Trees do not occur in this association.

Table C242. Most Abundant Species

Stratum	Species
Shrub	*Chilopsis linearis, Fallugia paradoxa*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC248.
Local Description Authors: H. Varani

***Fallugia paradoxa / Ungnadia speciosa* Shrubland**
Apache Plume / Mexican-buckeye Shrubland (Table C243)

Identifier: CEGL002719

Table C243. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Fallugia paradoxa* / *Ungnadia speciosa* Shrubland

Distribution
This uncommon association occurs along drainages on valley floor floodplain and alluvial flats near Cuttoff Ridge and Brush Mountain in Guadalupe Mountains NP.

Environmental Description
This association can be found in elevations ranging from 4,606 to 5,207 ft (1,404 to 1,587 m) along drainages. Sites are range from 12 to 20% slope with westerly aspects. Sites were rocky ranging from 50 to 65% surface rock and 4 to 39% surface gravel. Cover of bare soil and litter were low, 3% and 5% on average, respectively. Geologic substrates at the sites are alluvial deposits and Goat Seep Limestone.

Soils at these sites are mapped in Bissett-Rock outcrop complex, 15 to 60 percent slopes (BRG) (Loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This diverse shrubland association has an open shrub canopy (<20% cover) composed up to 20 species. *Fallugia paradoxa*, *Ungnadia speciosa*, *Rhus virens* var. *virens* and *Viguiera stenoloba* are the most consistent and dominant shrubs (Table C244). Other shrubs present with lower cover may include *Aloysia wrightii*, *Cercocarpus montanus* var. *paucidentatus*, *Choisya dumosa*, *Dasylirion leiophyllum*, *Ephedra aspera*, *Fouquieria splendens*, *Leucophyllum minus*, *Opuntia engelmannii*, *Prosopis glandulosa*, *Rhus trilobata*, *Sophora secundiflora*, *Yucca torreyi*, *Ziziphus obtusifolia* and subshrubs *Gutierrezia sarothrae* and *Parthenium incanum*. The herbaceous layer does not exceed 20% cover, and is generally grass dominated. Of these *Bouteloua curtipendula* is always present and may exceed 15% cover, while *Eragrostis intermedia*, *Bothriochloa barbinodis*, and *Tridens muticus* are the most common of the 27 other species which rarely exceed 5% cover each. Of the 52 mostly scattered species of forbs, *Melampodium leucanthum*, and *Viguiera dentata* are the most common.

Table C244. Most Abundant Species

Stratum	Species
Shrub	*Fallugia paradoxa, Ungnadia speciose, Rhus virens* var. *virens, Viguiera stenoloba*

Other Noteworthy Species
Data are not available

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ058, 07CJ064.
Local Description Authors: K.A. Schulz

Fallugia paradoxa Desert Wash Shrubland

Apache Plume Desert Wash Shrubland (Table C245)

Identifier: CEGL002716

Table C245. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Fallugia paradoxa* Desert Wash Shrubland

Distribution

This common association is scattered along the escarpment flanks in the Guadalupe Pass, Eastern Alluvial Uplands, and Bajadas areas of Guadalupe Mountains NP. An additional site can be found in West Dog Canyon of the Basin and Range area.

Environmental Description

This association can be found in elevations ranging from 4,806 to 6,201 ft (1,465 to 1,890 m) in arroyos. Sites are very gently sloped with variable aspects, and under the shrubs are 57% bare on average (some sites are rockier, some feature more gravel, and a few sites are substantially of exposed soils). Litter is also usually substantial and covers an average of 28% of the vegetated interspaces. Geologic substrates at the site are older and younger alluvial deposits, with one site situated on the Cherry Canyon Formation.

Soils at these sites are mapped in the five following units. Pinery, Choza, and Altuda, 5 to 60% slopes (PCG) (very rocky loamy-skeletal, mixed, superactive, thermic Calciustolls that may be further classified respective to series as Lithic, shallow Petrocalci, or Aridic), McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls), Chilicotal-Chispa complex, 3 to 13% slopes (CCD) (loamy-skeletal, mixed, superactive, thermic Ustic Haplocalcids or fine-loamy, mixed, superactive, thermic Ustic Haplocalcids respective to series), Bonespring-Rock outcrop complex, 10 to 60% slopes (BSG) (loamy-skeletal, mixed, superactive, calcareous, thermic Aridic Lithic Ustorthents) and Lazarus loam, 2 to 9% slopes (LAD)(fine-silty, mixed, superactive, mesic Pachic Argiustolls) (USDA NRCS and USDI NPS 2010).

Vegetation Description

This diverse shrubland association can feature very abundant to luxuriant shrub canopies composed of 32 species. *Fallugia paradoxa* is the dominant (Table C246) among the other poorly represented and scattered species that most often include *Viguiera stenoloba*, *Dasylirion leiophyllum*, *Opuntia engelmannii*, and *Cylindropuntia imbricata*. Above the shrubs, trees are generally absent. The sometimes abundant canopy includes six species, these dominated by *Juniperus deppeana*, and including *Quercus grisea*, *Juniperus monosperma*, *Juglans microcarpa*, *Juniperus pinchotii*, and *Celtis laevigata* var. *reticulata*. Below the shrubs, subshrubs average 4% cover, are occasionally absent, and, include a variety of 17 species (most commonly *Parthenium incanum*, *Agave parryi* ssp. *neomexicana*, and *Gutierrezia sarothrae*). The herbaceous layer does not exceed 35% cover, and is generally grass dominated. Of these *Bouteloua curtipendula* is always present and may exceed 15% cover, while *Eragrostis intermedia*, *Bothriochloa barbinodis*, and *Tridens muticus* are the most common of the 27 other species which rarely exceed 5% cover each. Of the 52 mostly scattered species of forbs, *Melampodium leucanthum*, and *Viguiera dentata* are the most common.

Table C246. Most Abundant Species

Stratum	Species
Shrub	*Fallugia paradoxa*

Other Noteworthy Species

Nama xylopodum is classified as a New Mexico rare plant that was found very near one site in this association type. Generally preferring partly shaded limestone cliffs and outcrops in montane scrub to piñon-juniper-oak woodland it can be found in Eddy, Otero, and Chaves counties in New Mexico, and in El Paso and Culberson counties of Texas in the Franklin and Guadalupe mountains.

Euphorbia davidii is an introduced annual forb, and was found twice in this association, exceeding 1% cover at one of the sites. *Ipomoea purpurea* (an introduced annual forb) was found scatted once. *Marrubium vulgar*e (a perennial forb) and *Verbascum thapsus,* a biennial forb, are associates occasionally found near sites.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 06YC237, 07CJ038, 07PA020, 08GM012, 08GM017, 08GM026, 08GM027.
Local Description Authors: H. Varani

Fallugia paradoxa - Brickellia laciniata Desert Wash Shrubland

Apache Plume - Splitleaf Brickellbush Desert Wash Shrubland (Table C247)

Identifier: CEPP006885

Table C247. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Fallugia paradoxa - Brickellia laciniata* Desert Wash Shrubland

Distribution

This uncommon association is known to occur in the Eastern Alluvial Uplands and Pine Spring Canyon areas of Guadalupe Mountains NP.

Environmental Description

This association can be found from 5,230 to 5,842 ft (1,594 to 1,781 m) along stream channels and in drainage bottoms. Locally, sites are alluvial, with slight slopes and southeastern aspects. Ground surfaces are gravelly, with rock and litter in the vegetated interspaces. Geologic substrates are older alluvial deposits.

Soils are mapped as McKittrick-Riverwash complex, 0 to 3% slopes (MCB) (loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls); this soil unit is known to flood periodically (USDA NRCS and USDI NPS 2010).

Vegetation Description

This shrubland association features 10 to 60% shrub cover generally dominated by *Fallugia paradoxa* and including or sometimes codominated by *Brickellia laciniata* (Table C248). The other eight shrub species recorded are scattered and variable. Trees rarely exceed 5% and are often absent; they may be represented by *Juglans microcarpa*,

or *Pinus edulis*. Subshrubs are a minor component, generally not exceeding 1% total cover; *Gutierrezia sarothrae* is the most common. The herbaceous understories can be forb or grass dominated, the combination of the two covering 8 to 30%. Among the six species of grasses recorded, the most common are *Bothriochloa barbinodis* and *Bouteloua curtipendula*, though *Eragrostis intermedia*, *Elymus elymoides*, and *Setaria leucopila* can be more abundant. Of the most common of the 29 recorded forb species (*Euphorbia davidii*, *Sphaeralcea incana*, *Chamaesyce chaetocalyx*, and *Cirsium undulatum* and *Viguiera dentata*) only the last exceeds 1% and is very abundant at one site.

Table C248. Most Abundant Species

Stratum	Species
Shrub	*Fallugia paradoxa, Brickellia laciniata*

Other Noteworthy Species

Ostrya knowltonii is recognized by the Flora of North America (1993+) as a rare plant. It is found at one of the sites in this association, and does not exceed 1% cover there. Generally found along streams and in moist canyons sporadically throughout the arid Southwest, the New Mexico population is considerably disconnected from the Arizona and Texas collections.

Euphorbia davidii (and annual species), *Marrubium vulgar*e, (a perennial species), and *Verbascum thapsus* (a biennial species) are introduced forbs scattered in this association.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM013, 08GM028, 08GM030.
Local Description Authors: H. Varani

Prosopis glandulosa Desert Wash Shrubland

Honey Mesquite Desert Wash Shrubland (Table C249)

Identifier: CEPP006992

Table C249. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Prosopis glandulosa* Desert Wash Shrubland

Distribution

This infrequent association occurs near the northernmost park boundary in the Bajadas area of Guadalupe Mountains NP.

Environmental Description

This site is situated at an elevation of 3,842 ft (1,171 m) in a gravel/cobble arroyo that is 5 to 10m wide. The site is very gently sloped with a southwestern aspect, and includes the un vegetated arroyo bed. Vegetation is thick along the arroyo edges. Geologic substrate at the site is of younger alluvial deposits.

Soil at the site is mapped as Chilicotal-Chispa complex, 3 to 13% slopes (CCD) which are loamy-skeletal (or fine-loamy), mixed, superactive, thermic Ustic Haplocalcids (USDA NRCS and USDI NPS 2010).

Vegetation Description
In this shrubland association, shrubs line the arroyo edges including both *Prosopis glandulosa*, and *Viguiera stenoloba* in excess of 5% cover each (Table C250); *Larrea tridentata* is the most abundant of the ten other shrubs. Three subshrubs are scattered in the understory including *Krameria grayi*, *Opuntia phaeacantha*, and *Parthenium incanum*. Grasses are abundant and composed of similar proportions of *Setaria leucopila*, *Eragrostis lehmanniana*, *Muhlenbergia porteri*, and *Sporobolus airoides*, and four other scattered species. Forbs are all scattered and scarce, the 11 species include *Allionia choisyi*, *Sartwellia flaveriae*, and various mustards *(Brassica* spp., *Descurainia* spp.).

Table C250. Most Abundant Species

Stratum	Species
Shrub	*Prosopis glandulosa, Viguiera stenoloba*
Herbaceous	*Setaria leucopila*

Other Noteworthy Species
Eragrostis lehmanniana is an introduced perennial grass species found poorly represented at this site.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM013, 08GM028, 08GM030.
Local Description Authors: H. Varani

***Juglans microcarpa - Fallugia paradoxa / Bouteloua curtipendula* Desert Wash Shrubland**
Little Walnut - Apache Plume / Sideoats Grama Desert Wash Shrubland (Table C251)

Identifier: CEPP006890

Table C251. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm-Desert Xeric - Riparian Scrub (M092)
Group	Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group [G541]
Association	*Juglans microcarpa - Fallugia paradoxa / Bouteloua curtipendula* Desert Wash Shrubland

Distribution
This infrequent association occurs in the Eastern Alluvial Uplands area of Guadalupe Mountains NP, near Pine Spring.

Environmental Description
This association is known to occur at 5,439 and 5,447 ft (1,658 and 1,660 m) on terraces with gentle slopes and easterly aspects. Sites are gravelly with some rock and litter in the vegetated interspaces. The geologic substrates for both sites are older alluvial deposits.

Soils are mapped as McKittrick-Riverwash complex soils, 0 to 3% slopes (MCB), these are rangeland soils which flood periodically, and are made up of loamy-skeletal, carbonatic, superactive, mesic Fluventic Haplustolls (USDA NRCS and USDI NPS 2010).

Vegetation Description

The open canopies of this forested wetland association reach 20% cover and are dominated by *Juglans microcarpa* (Table C252). The very abundant shrub cover is composed mainly by *Fallugia paradoxa*, but *Brickellia laciniata* can be abundant, and *Opuntia engelmannii*, *Cylindropuntia imbricata* and *Agave parryi* ssp. *neomexicana* are consistently present. Herbaceous cover reaches 35% through a combination of graminoids and forbs, (dominated only slightly by grasses). *Bouteloua curtipendula* is the only abundant and dominant species in the herbaceous layer, though other common grass elements include *Bothriochloa laguroides* ssp. *torreyana*, *Eragrostis intermedia*, and *Setaria leucopila*. 26 forbs have been recorded in this association, most are scattered. Consistent between both sites are *Viguiera dentata*, *Euphorbia davidii*, *Marrubium vulgar*e, *Mentzelia oligosperma*, and *Convolvulus equitans*. At one site, *Chamaesyce serpyllifolia* exceeds 5% cover.

Table C252. Most Abundant Species

Stratum	Species
Tree Canopy	*Juglans microcarpa*
Shrub Canopy	*Fallugia paradoxa*
Herb	*Bouteloua curtipendula*

Other Noteworthy Species

Introduced species found on site include the annual *Euphorbia davidii*, the perennial *Marrubium vulgar*e, and the biennial *Erodium cicutarium*. Of these, only *Euphorbia davidii* exceeds 1% cover at both sites.

Element Sources

Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 08GM016, 08GM018.
Local Description Authors: H. Varani

G819 North American Warm Desert Ruderal Scrub Group

***Prosopis glandulosa / Sporobolus flexuosus* Ruderal Shrubland**

Honey Mesquite / Mesa Dropseed Ruderal Shrubland (Table C253)

Identifier: CEGL001386

Table C253. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Warm Desert & Semi-Desert Woodland, Scrub & Grassland (3.A)
Formation	Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
Division	North American Warm Desert Scrub & Grassland (3.A.2.Na)
Macrogroup	North American Warm Desert Ruderal Scrub & Grassland (M512)
Group	North American Warm Desert Ruderal Scrub Group [G819]
Association	*Prosopis glandulosa/ Sporobolus flexuosus* Ruderal Shrubland

Distribution
This ruderal association is known from the quartzose dunes of the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This site is recorded at an elevation of 3,655 ft (1,114 m).The ground surface is mainly sand, with the site featuring 20% cryptogram cover. Geologic substrates are younger alluvial deposits.

Soil at the site is mapped as Copia loamy fine sand, 2 to 7% slopes (COC), which are mixed, thermic Typic Torripsamments (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association is very scattered, featuring unevenly distributed, coppiced or slightly elevated islands of *Prosopis glandulosa* (Table C254). *Atriplex canescens* is also occasionally scattered, along with the dwarf-shrub *Gutierrezia sarothrae*. Forbs are sparse, and largely represented by *Croton pottsii*, and include *Dimorphocarpa wislizeni*, *Salsola tragus*, and globemallows (*Sphaeralcea* spp.). Minute amounts of *Sporobolus flexuosus* and *Dasyochloa pulchella* represent the very sparse graminoid component. Trees do not occur in this association.

Table C254. Most Abundant Species

Stratum	Species
Shrub	*Prosopis glandulosa*
Herb	*Sporobolus flexuosus*

Other Noteworthy Species
Salsola tragus is an introduced annual forb and scattered associate observed at this site.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ069.
Local Description Authors: H. Varani

G300 Intermountain Shadscale - Saltbush Scrub Group

***Atriplex canescens / Sporobolus airoides* Shrubland**
Fourwing Saltbush / Alkali Sacaton Shrubland (Table C255)

Identifier: CEGL001291

Table C255. US National Vegetation Classification

Level	Unit
Class	Desert & Semi-Desert (3)
Subclass	Cool Semi-Desert Scrub & Grassland (3.B)
Formation	Cool Semi-Desert Scrub & Grassland (3.B.1)
Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin Saltbush Scrub (M093)
Group	Intermountain Shadscale - Saltbush Scrub Group [G300]
Association	*Atriplex canescens / Sporobolus airoides* Shrubland

Distribution
This infrequent association can be found near the westernmost park boundary, in the Sand Dunes area of Guadalupe Mountains NP.

Environmental Description
This association occurs in the elevations ranging from 3,632 to 3,652 ft (1,107 to 1,113 m) in flat locations with silty soils. Sites feature 10 to 40% cryptogrammic crust growth, and average nearly 30% exposed soil cover. Geologic substrates are younger alluvial deposits.

Soils at these sites are mapped as Monahans-Pajarito complex, 0 to 5% slopes (MPB) (coarse-loamy, mixed, superactive, thermic Typic Calcigypsids, and coarse-loamy, mixed, superactive, thermic Typic Haplocambids, respective to series) (USDA NRCS and USDI NPS 2010).

Vegetation Description
This shrubland association can feature up to 50% shrub cover, composed of *Atriplex canescens* generally (Table C256), sometimes codominated by *Prosopis glandulosa*. Occasionally *Cylindropuntia imbricata* and the subshrubs *Opuntia macrocentra*, *Suaeda nigra*, *Desmanthus cooleyi*, and *Gutierrezia sarothrae* are scattered among the dominants. Understories are grassy in character, and dominated by *Sporobolus airoides*, sometimes with abundant populations of *Scleropogon brevifolius*; often *Muhlenbergia porteri* is also present. Forbs are usually present, but vary from site to site and may be nearly absent, *Sartwellia flaveriae* and *Sphaeralcea hastulata* are poorly represented at half of the visited sites. No trees occur in this association.

Table C256. Most Abundant Species

Stratum	Species
Shrub	*Atriplex canescens*
Grass	*Sporobolus airoides*

Other Noteworthy Species
Salsola tragus is an introduced annual forb species, and was found scattered at one site in this association.

Element Sources
Data: Guadalupe Mountains NP PLOTS. MDB database available at https://www.nps.gov/im/vegetation-inventory.htm.
NHNM Plots: 07CJ065, 07CJ067, 07CJ071, 07YC056.
Local Description Authors: H. Varani

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Appendix D. A Vegetation Classification and Map: Guadalupe Mountains National Park: Annotated Vegetation Map Legend

This annotated map legend for the vegetation map of Guadalupe Mountains National Park (NP) is based on Tables 6A–6Q of the main report. Scientific names for plant species in map unit descriptions are found in Appendix A. For each Level 2 unit, we provide a description with the following.

- A list of component plant associations by prevalence: Primary (collectively representing more than 50% of the map unit distribution); Secondary (collectively less than 50% of the area).
- Elevation range derived from the GIS.
- A summary of the distribution, environment, and floristic composition of the unit.
- A representative ground photograph.
- A distribution map of the unit with black polygons shown for each unit.
- An image map showing the delineation of a representative polygon(s) in the 2016 color aerial photography (Photo Map Detail).
- The total hectares and acres of the unit and number of polygons as derived from the GIS.

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1 Madrean Upper Montane Conifer - Oak Forest & Woodland

1A Madrean Upper Montane Conifer - Oak Woodland Savanna

Area: 831.9 Ha; 2,056 Acres
Polygons: 251

Primary Component Associations
Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora Forest
Pseudotsuga menziesii / Muhlenbergia pauciflora Forest
Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum Forest

Secondary Component Associations
Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica Forest
Pinus strobiformis / Festuca arizonica Forest

Summary
These are open-canopied woodland savannas dominated by Douglas-fir and southwestern white pine with grassy understories (ponderosa pine may be present but not dominant or codominant). Characteristic grasses are New Mexico muhly, pine muhly, pinyon ricegrass, and Arizona fescue. Gambel oak, wavy leaf oak, and New Mexico locust are common short trees and shrubs that occur in scattered patches.

These woodlands occur at the highest elevations of the park; usually on platform summits, ridges, and upper slopes of northern exposure (Figures D1–D3).



Figure D2. Elev.: 5,367 to 8,611 ft (1,636 to 2,625 m)

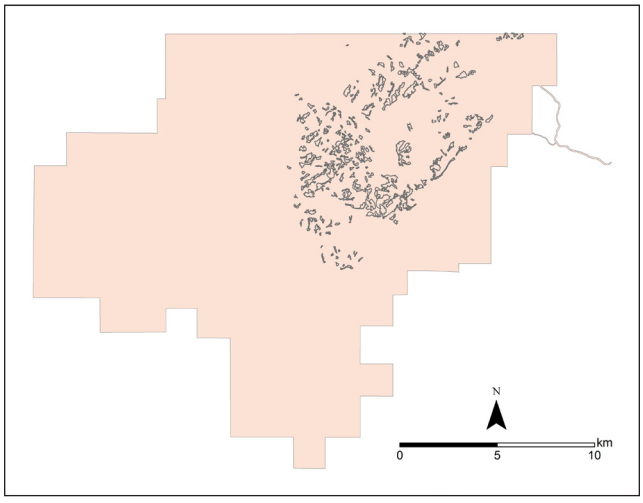


Figure D1. Distribution

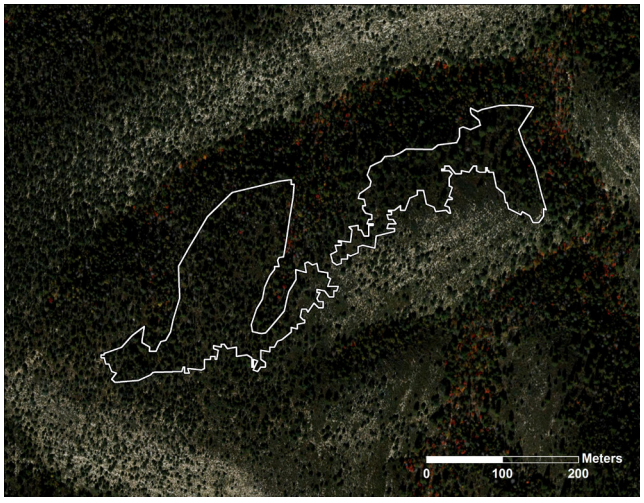


Figure D3. Photo Map Detail

1B Madrean Upper Montane Conifer - Oak Dry Forest

Area: 1,147 Ha; 2,834 Acres
Polygons: 263

Primary Component Associations
Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii Forest

Secondary Component Associations
Pseudotsuga menziesii - Ostrya knowltonii Forest

Summary
These are moderate- to closed-canopied forests (40–80% canopy cover) dominated by Douglas-fir and southwestern white pine with an understory of mesic small trees and shrubs that include Knowlton's hophornbeam, Gambel oak, rockspirea, snowberry, littleleaf mockorange, and Utah serviceberry. The herbaceous layer is a mix of scattered grasses and forbs that include little awn needlegrass, Arizona fescue, New Mexico muhly, and upland sedges such as Ross's sedge among the graminoids and peavine, Fendler's meadowrue, pineywoods geranium, and nodding onion among the forbs.

These forests occur at the highest elevations of the park; usually on steep mid to upper slopes of northern exposure, but they can extend onto platform summits (Figures D4–D6).

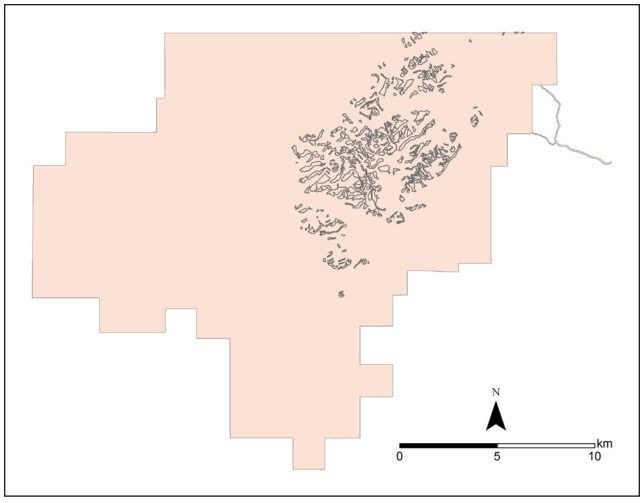


Figure D4. Distribution



Figure D5. Elev.: 5,429 to 8,728 ft (1,655 to 2,660 m)

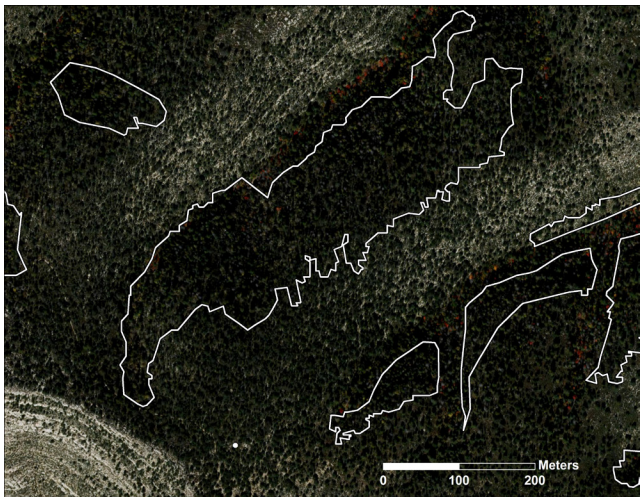


Figure D6. Photo Map Detail

1C Madrean Upper Montane Conifer - Oak - Maple Moist Mesic Forest

Area: 799.8; 1,976 Acres
Polygons:102

Primary Component Associations

Pseudotsuga menziesii - Acer grandidentatum - Quercus muehlenbergii Forest
Pseudotsuga menziesii - Acer grandidentatum - Ostrya knowltonii Forest
Pseudotsuga menziesii - Acer grandidentatum - Quercus gambelii Forest
Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii Forest
Pinus strobiformis - Acer grandidentatum - Ostrya knowltonii Forest
Pinus strobiformis - Acer grandidentatum - Quercus gambelii Forest

Secondary Component Associations

Pinus strobiformis - Quercus muehlenbergii Forest
Populus tremuloides - Pinus strobiformis / Ostrya knowltonii Forest
Acer grandidentatum - Quercus muehlenbergii Forest
Acer grandidentatum / Quercus gambelii Forest

Summary

These are moderate- to closed-canopied forests (40–90% canopy cover) dominated by Douglas-fir and southwestern white pine with bigtooth maple and chinkapin oak as codominants or in the subcanopy. The understory can be diverse and includes mesic small trees and shrubs such as Knowlton's hophornbeam, Gambel oak, cliff fendlerbrush, black cherry, canyon grape, western white honeysuckle, rockspirea, littleleaf mockorange, Oregongrape and Utah serviceberry. The herbaceous layer is a mix of scattered grasses and forbs that include little awn needlegrass, Arizona fescue, New Mexico muhly, and upland sedges such as Ross's sedge among the graminoids and peavine, Fendler's meadowrue, pineywoods geranium, and nodding onion among the forbs.



Figure D8. Elev.: 5,260 to 8,429 ft (1,603 to 2,569 m)

These forests are a common occurrence on cooler slopes of mountain canyons and in ravines and they extend down into lower-elevation riparian zones (Figures D7–D9).

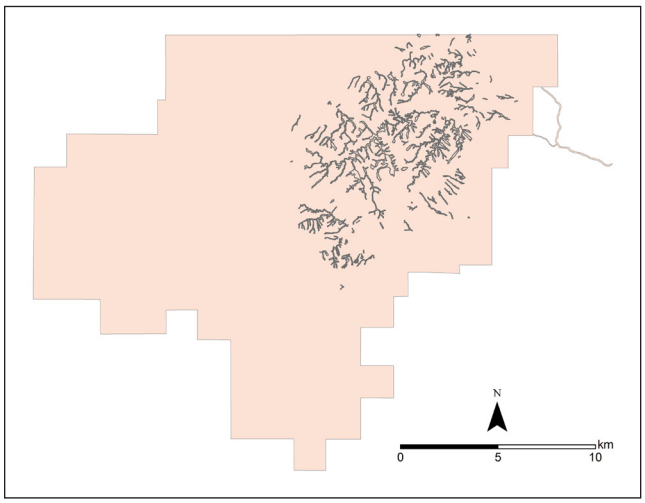


Figure D7. Distribution

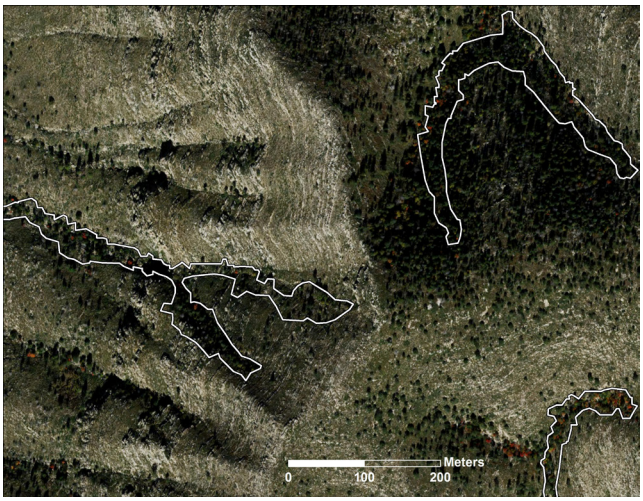


Figure D9. Photo Map Detail

2 Madrean Lower Montane Pine - Oak Forest & Woodland

2A Madrean Ponderosa Pine / Gambel and Wavyleaf Oak Woodland

Area: 349.3 Ha; 863.1 Acres
Polygons: 117

Primary Component Associations
Pinus ponderosa / *Muhlenbergia pauciflora* Forest
Pinus ponderosa / *Quercus gambelii* / *Piptochaetium fimbriatum* Forest
Pinus ponderosa / *Quercus* × *pauciloba* / *Muhlenbergia pauciflora* Forest
Pinus ponderosa / *Quercus* × *pauciloba* / *Piptochaetium fimbriatum* Forest

Secondary Component Associations
Pinus ponderosa - Quercus gambelii / *Festuca arizonica* Forest

Summary
These are open-canopied woodland savannas dominated by ponderosa pine with grassy understories (Douglas-fir or southwestern white pine may be present but not dominant or codominant). Characteristic grasses are New Mexico muhly, pine muhly, pinyon ricegrass, and Arizona fescue. Gambel oak is prevalent as short trees and shrubs along with New Mexico locust. Common forbs include nodding onion, wavyleaf thistle, manyflowered gromwell, and American vetch.

These woodlands have a limited distribution at higher elevations of the central mountain zone of the park—usually on platform summits, ridges, and upper slopes of southern exposure (Figures D10–D12). Sites likely have a mixed fire regime of surface and small-patch crown fires.



Figure D11. Elev.: 6,078 to 8,618 ft (1,853 to 2,627 m)

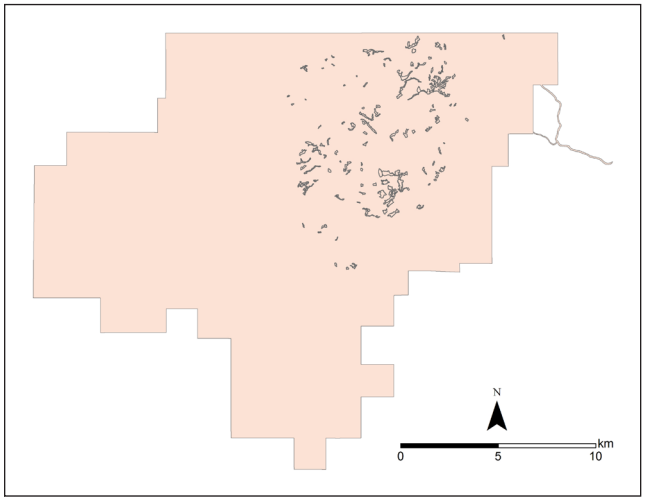


Figure D10. Distribution

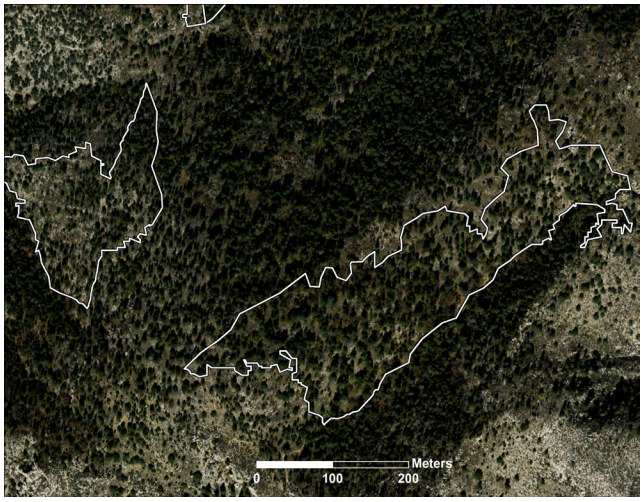


Figure D12. Photo Map Detail

2B Madrean Lower Montane Ponderosa Pine - Bigtooth Maple - Chinkapin Oak Canyon Woodland

Area: 156.5 Ha; 386.6 Acres
Polygons: 39

Primary Component Associations
Pinus ponderosa - Acer grandidentatum - Quercus muehlenbergii Forest
Acer grandidentatum - Quercus muehlenbergii Forest

Secondary Component Associations
Acer grandidentatum / Quercus gambelii Forest

Summary
These are open- to closed-canopied forests and woodlands (25–80% canopy cover) dominated by ponderosa pine, bigtooth maple and chinkapin oak as codominants along with alligator juniper, Knowlton's hophornbeam and Texas madrone in the subcanopy. Typical shrubs include Gambel oak, wavyleaf oak, green sotol, cliff fendlerbrush, black cherry, and skunkbush sumac. Sites can be grassy to sparse with New Mexico muhly, little bluestem, bullgrass, and pinyon ricegrass being the most common grasses. Forbs include plumed brickellbush, bracted bedstraw, Schied's flax, thistle, trailing fleabane, ribbed false pennyroyal, and branched noseburn.

These forests have a limited distribution on warmer slopes of mountain canyons and ravines and extend down into lower elevation riparian zones (Figures D13–D15). The fire regime is unknown, but fire is likely relatively uncommon in these mesic sites.



Figure D14. Elev.: 5,186 to 8,038 ft (1,581 to 2,450 m)

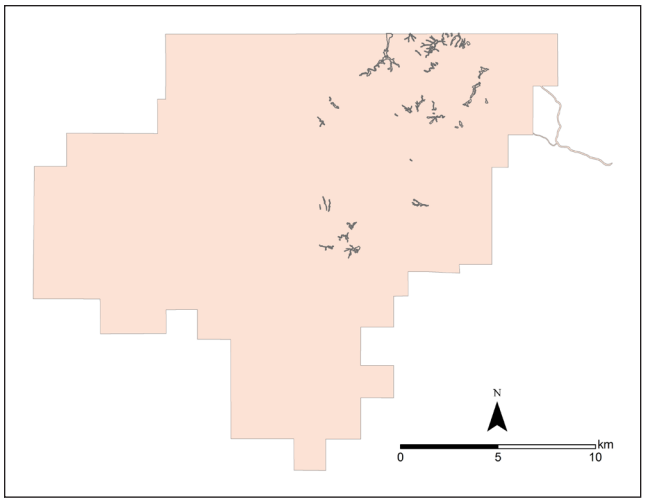


Figure D13. Distribution

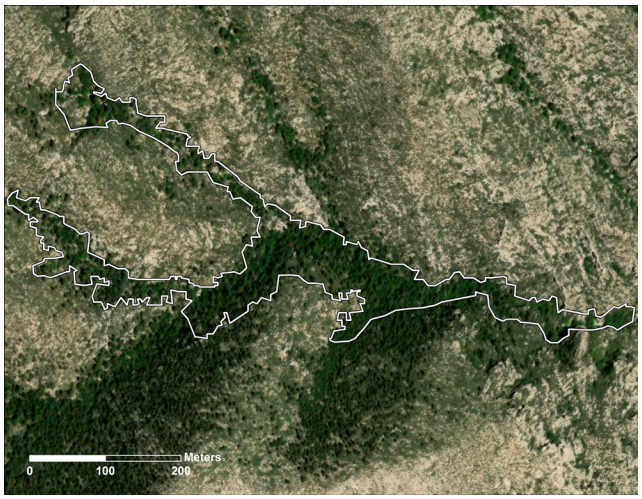


Figure D15. Photo Map Detail

3. Madrean Pinyon - Juniper Woodland

3A. Madrean Two-needle Pinyon - Alligator Juniper / New Mexico Muhly Woodland

Area: 228.9 Ha; 565.6 Acres
Polygons: 91

Primary Component Associations
Pinus edulis / *Muhlenbergia pauciflora* Woodland
Juniperus deppeana / *Muhlenbergia pauciflora* Woodland

Secondary Component Associations
Pinus edulis - Juniperus deppeana / *Piptochaetium fimbriatum* Woodland
Pinus edulis / *Muhlenbergia setifolia* Woodland

Summary

These are open- to moderate-canopied woodlands dominated by pinyon pine and junipers (alligator juniper, oneseed juniper, or Rocky Mountain juniper). Wavyleaf oak and mountain mahogany can be present but not dominant. The herbaceous layer is typically grassy and dominated by New Mexico muhly, pine muhly, pinyon ricegrass, sideoats grama, and plains lovegrass in a mix of a wide variety of forbs.

These woodlands are scattered at mid to upper elevations of the central mountain zone of park—usually on relatively dry and rocky upper slopes and ridges (Figures D16–D18). These tend to be persistent woodlands where natural fire is relatively uncommon.



Figure D17. Elev.: 5,833 to 8,596 ft (1,778 to 2,620 m)

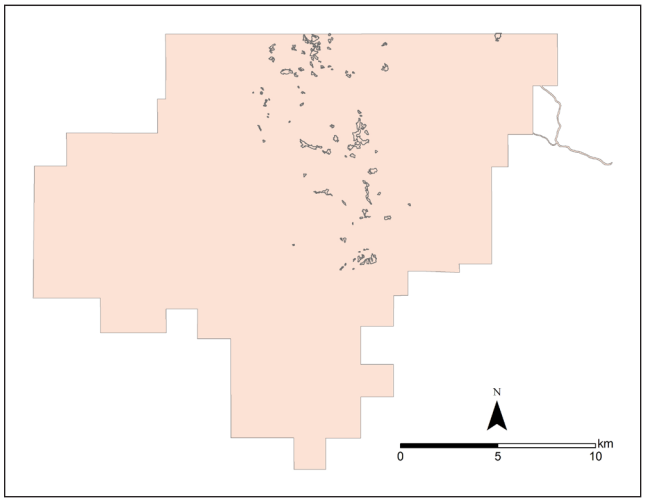


Figure D16. Distribution

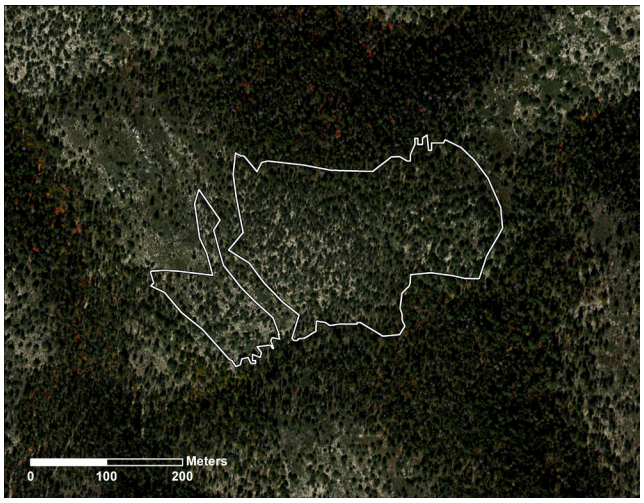


Figure D18. Photo Map Detail

3B Madrean Two-needle Pinyon - Alligator Juniper / Finestem Needlegrass - Blue Grama Woodland Savanna

Area: 249.2 Ha; 615.7 Acres
Polygons: 42

Primary Component Associations
Pinus edulis / *Nassella tenuissima* Woodland
Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / *Bouteloua gracilis* Open Woodland
Juniperus deppeana / *Bouteloua gracilis* Woodland

Summary
These open woodland savannas are dominated by pinyon pine and junipers (alligator juniper, oneseed juniper, or Rocky Mountain juniper). Shrub cover is limited and intertree spaces are grassy. Characteristic grasses include blue grama, sideoats grama, finestem needlegrass, bristly wolfstail, and vine mesquite. Common forbs include white milkwort, slimleaf plainsmustard, birdbill dayflower, and Colorado four o'clock.

These woodlands are limited to the north-central hill country of the park. They represent the lower-elevation end of the pinyon-juniper zone and occur on rolling hills and flats of northerly aspects (Figures D19–D21). Recurring surface fires likely maintain the open character of these woodlands.



Figure D20. 6,030 to 6,935 ft (1,838 to 2,114 m)

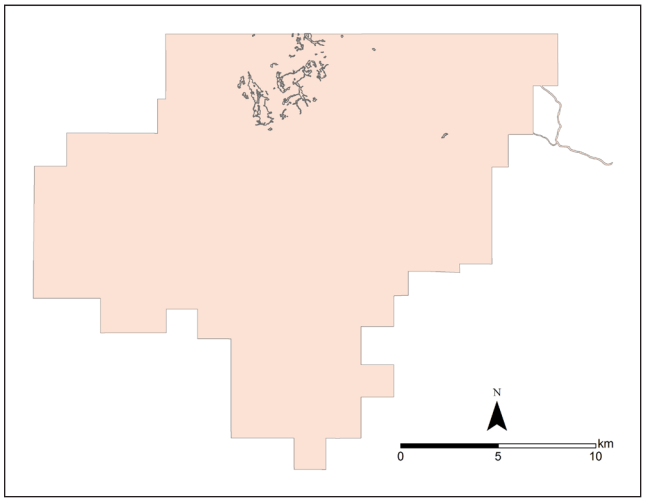


Figure D19. Distribution

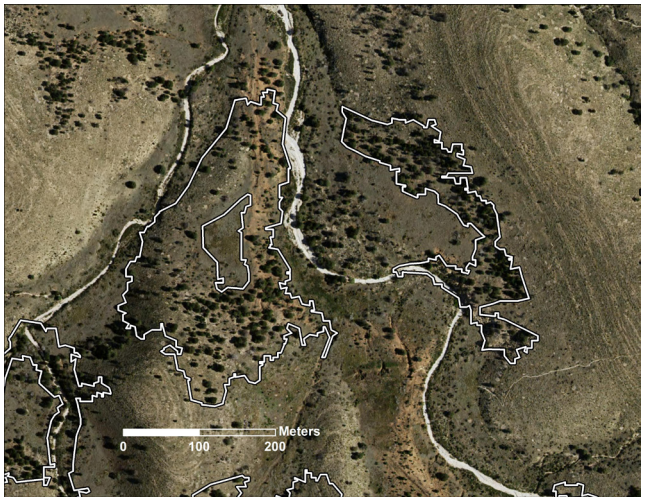


Figure D21. Photo Map Detail

3C Madrean Two-needle Pinyon - Alligator Juniper / Wavyleaf Oak - Mountain Mahogany Woodland

Area: 904.4 Ha; 2,235 Acres
Polygons: 298

Primary Component Associations
Pinus edulis / *Quercus* × *pauciloba (Cercocarpus montanus* var. *paucidentatus)* / *Muhlenbergia pauciflora* Woodland
Juniperus deppeana / *Quercus* × *pauciloba* / *Bouteloua curtipendula* Woodland

Summary
These are moderate- to closed-canopied woodlands dominated by pinyon pine and alligator juniper. A conspicuous shrub layer dominated by wavyleaf oak and mountain mahogany is characteristic, along with a diverse mix of other shrubs and subshrubs (banana yucca, Texas sacahuista, desert ceanothus, skunkbush sumac, and Parry's agave). Grasses can also be abundant and include New Mexico muhly, pine muhly, pinyon ricegrass, sideoats grama, plains lovegrass, and bullgrass, along with a diverse mix of forbs.

These woodlands are found extensively at mid to upper elevations of the central hill and mountain zone of the park. They occur on relatively steep and rocky upper slopes and ridges of southerly aspects, but stands can extend onto platform summits (Figures D22–D24). These tend to be persistent woodlands where natural fire is relatively uncommon.



Figure D23. Elev.: 5,185 to 8,679 ft (1,580 to 2,645 m)

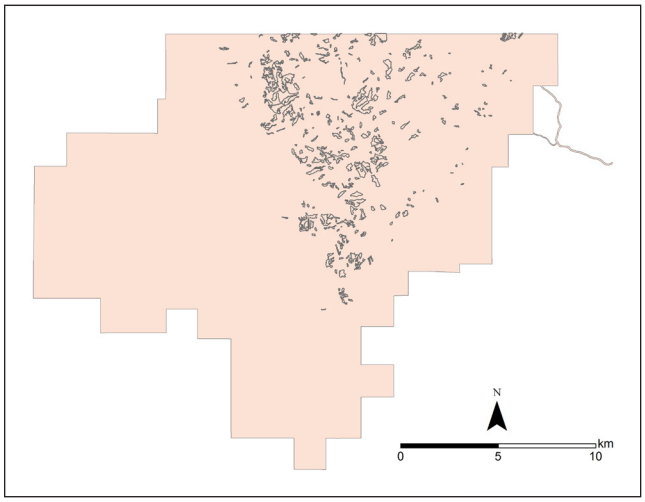


Figure D22. Distribution

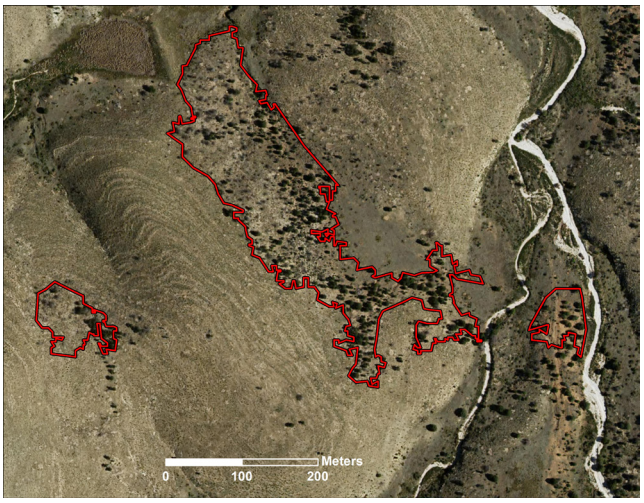


Figure D24. Photo Map Detail

4 Madrean Encinal

4A Madrean Gray Oak - Alligator Juniper Foothill Woodland Savanna

Area: 229.6 Ha; 567.2 Acres
Polygons: 68

Primary Component Associations

Quercus grisea - Juniperus deppeana / *Muhlenbergia emersleyi (Bouteloua* spp.) Woodland

Secondary Component Associations

Juniperus deppeana / *Quercus* × *pauciloba* / *Bouteloua curtipendula* Woodland

Summary

These are open woodland savannas dominated by gray oak and alligator juniper. Pines are uncommon or absent. Shrub cover is typically limited but on occasion wavyleaf oak and shrubby gray oak may be prevalent. The rosetophilous shrubs green sotol and Texas sacahuista that are common in desert grasslands may also be prevalent. The intertree spaces are grassy and dominated by bullgrass, sideoats grama, blue grama, hairy grama, and plains lovegrass. Common forbs include branched noseburn, trailing fleabane, plumed brickellbush, and white milkwort.

These woodland savannas have a limited distribution at lower elevations below the pinyon zone on moderate to low slopes, rolling hills, and flats. Aspects tend to be southerly (Figures D25–D27). Recurring surface grass fires likely maintain the open savanna-like character of the sites.



Figure D26. Elev.: 4,961 to 7,280 ft (1,512 to 2,219 m)

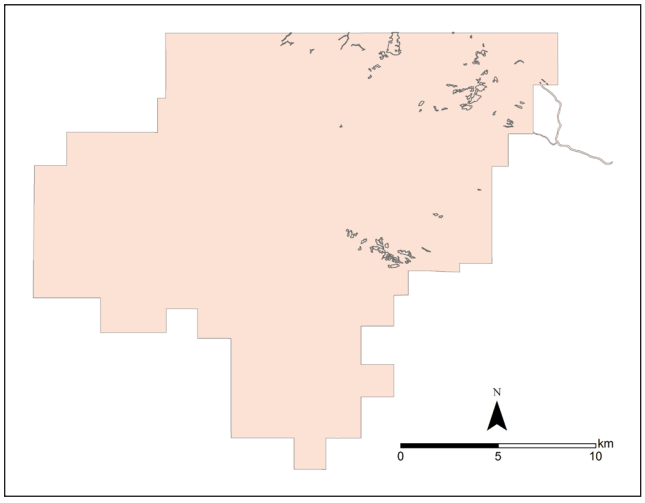


Figure D25. Distribution

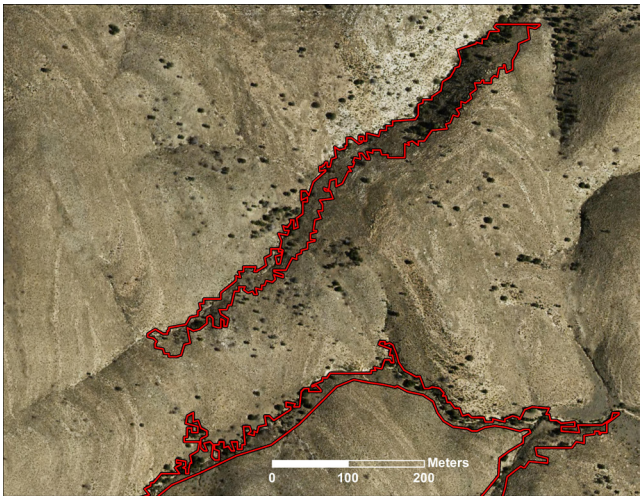


Figure D27. Photo Map Detail

4B Madrean Gray Oak - Alligator Juniper Canyon and Dry Wash Woodland

Area: 394.8 Ha; 975.6 Acres
Polygons: 190

Primary Component Associations
Quercus grisea - Juniperus deppeana / Muhlenbergia pauciflora Woodland
Quercus grisea - Arbutus xalapensis Woodland
Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi (*Bouteloua* spp.) Woodland

Secondary Component Associations
Quercus grisea - Juniperus deppeana / Piptochaetium fimbriatum Woodland
Fallugia paradoxa Arroyo Wash Shrubland
Dry Wash

Summary
These are open- to moderate-canopied woodlands savannas dominated by gray oak and alligator juniper. Pines are uncommon or absent. Texas madrone along with the rosetophilous shrubs green sotol and Texas sacahuista are prevalent in the understory along with species common to dry washes such as Apache plume, yerba de pasmo, and California brickellbush. Sites can be grassy, dominated by bullgrass, sideoats grama, and plains lovegrass. Common forbs include branched noseburn, trailing fleabane, toothleaf goldeneye, and plains blackfoot.

These woodlands are limited to lower elevations along dry drainages, alluvial terraces, and lower slopes mostly on the eastern side of the park (Figures D28–D30).



Figure D29. Elev.: 4,675 to 7,995 ft (1,425 to 2,437 m)

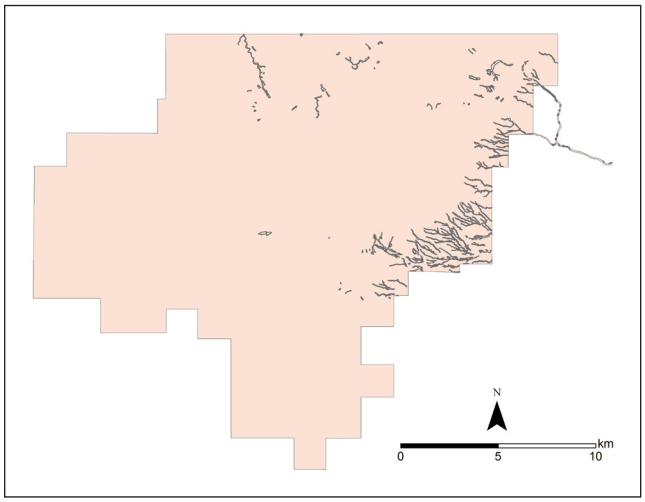


Figure D28. Distribution

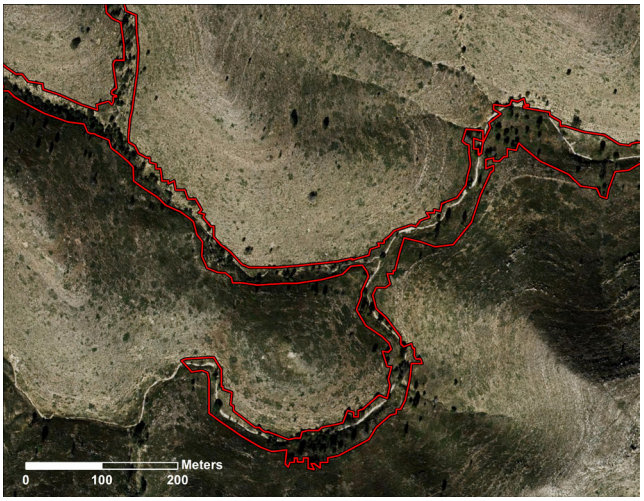


Figure D30. Photo Map Detail

5 Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland

5A Gambel Oak - New Mexico Locust Shrubland

Area: 122.1 Ha; 301.7 Acres
Polygons: 61

Primary Component Associations
Quercus gambelii / *Robinia neomexicana* Shrubland
Quercus gambelii / *Piptochaetium fimbriatum - Festuca arizonica* Woodland
Robinia neomexicana / *Piptochaetium fimbriatum* Shrubland

Secondary Component Associations
Quercus gambelii / *Carex inops* Shrubland

Summary
These deciduous, often dense montane shrublands are dominated by Gambel oak and/or New Mexico locust with understories that tend to be grassy and dominated by pinyon ricegrass and Arizona fescue. The forbs are represented by mesic species such as pineywoods geranium, sagewort, and peavine.

These shrublands are mostly restricted to high mountain areas of the park where they are found on northerly cool slopes and summits (Figures D31–D33). Typically, these are successional communities following fires in Madrean Upper Montane Conifer - Oak Dry Forest. Accordingly, conifer reproduction may be present, but the oak shrub stage may persist with repeated fire and coupled with the clonal spread of the oaks.



Figure D32. Elev.: 5,211 to 8,509 ft (1,588 to 2,594 m)

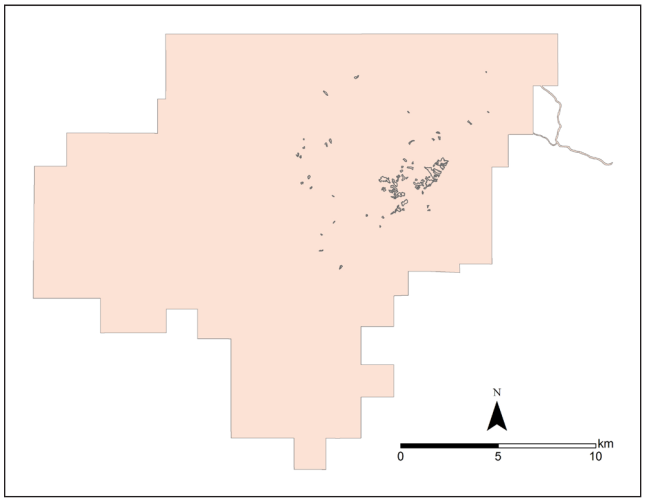


Figure D31. Distribution

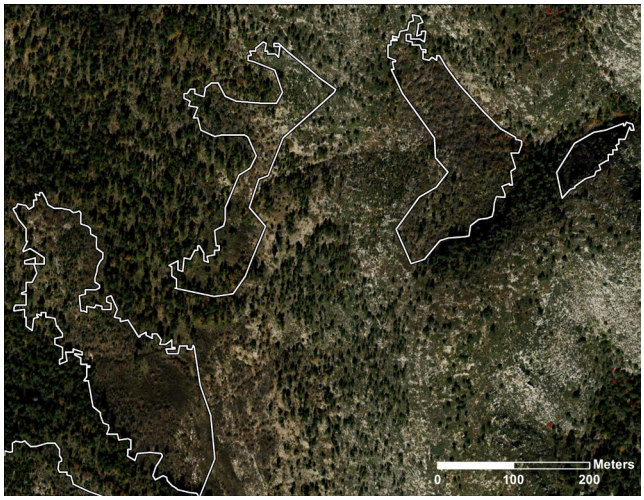


Figure D33. Photo Map Detail

6 Eastern Madrean Chaparral

6A Pinchot's Juniper - Scrub Oak / Curlyleaf Muhly Shrubland

Area: 1,028 Ha; 2,541 Acres
Polygons: 159

Primary Component Associations
Juniperus pinchotii / *Quercus (pungens,* × *pauciloba)* / *Muhlenbergia setifolia* Woodland

Secondary Component Associations
Quercus pungens / *Muhlenbergia setifolia* Shrubland

Summary
This oak open shrubland along the eastern flank of the park is dominated by short-statured Pinchot's juniper and pungent oak with grassy intershrub spaces dominated by a mix of species that includes curlyleaf muhly, hairy grama, plains lovegrass, sideoats grama, hairy woollygrass, bristly wolfstail, slim tridens, and a wide variety of forbs.

This shrubland is found extensively on lower-elevation foothills and alluvial fan piedmonts of the eastern flank of the park (Figures D34–D36). Recurring fire likely maintains the open character of the shrubland, and on drier sites may preclude juniper establishment.



Figure D35. Elev.: 4,716 to 6,699 ft (1,437 to 2,042 m)

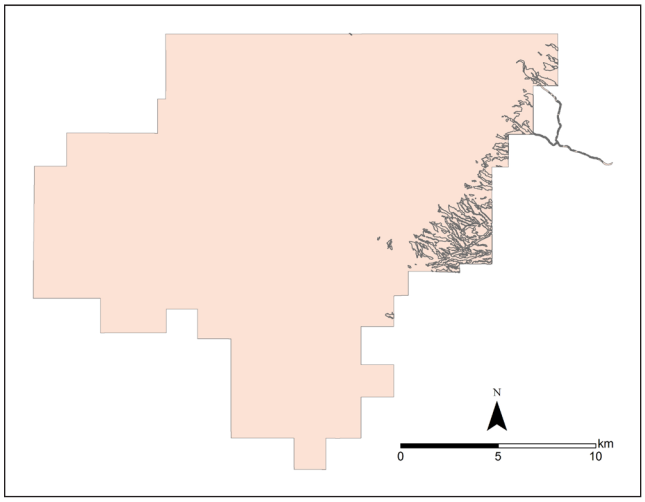


Figure D34. Distribution

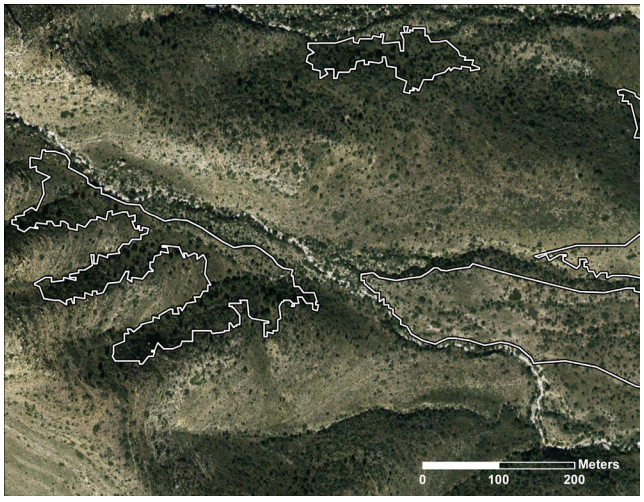


Figure D36. Photo Map Detail

6B Pungent Oak - Wavyleaf Oak Shrubland

Area: 2,892 Ha; 7,146 Acres
Polygons: 469

Primary Component Associations
Quercus (pungens, × *pauciloba) / Muhlenbergia pauciflora* Shrubland
Quercus × *pauciloba / Cercocarpus montanus* Shrubland

Secondary Component Associations
Quercus × *pauciloba / Achnatherum lobatum* Shrubland
Rockland

Summary
This shrubland can form dense stands of wavyleaf oak or pungent oak along with mountain mahogany, desert ceanothus, skunkbush sumac, and Goldman's silktassel among others. It typically follows fire in ponderosa pine and pinyon-juniper woodlands and there may be scattered trees throughout the stands or at the borders. Grasses can be prevalent and are dominated by New Mexico muhly, plains lovegrass, little awn needlegrass, pine muhly, and sideoats grama along with a mix of scattered forbs.

This shrubland is found extensively throughout most of the mountain zone of the park where it tends to occur on mid to high-elevation sites. At lower elevations, stands occur on steep, cooler aspects but they also occur at high elevation ridges and summits of warmer aspect (Figures D37–D39). Commonly, these are successional shrublands following fire in pinyon-juniper or encinal woodlands, and conifer regeneration may be present. The shrublands become more persistent with repeated fire that can encourage clonal oak expansion.



Figure D38. Elev.: 4998 to 8756 ft (1523 to 2669 m)

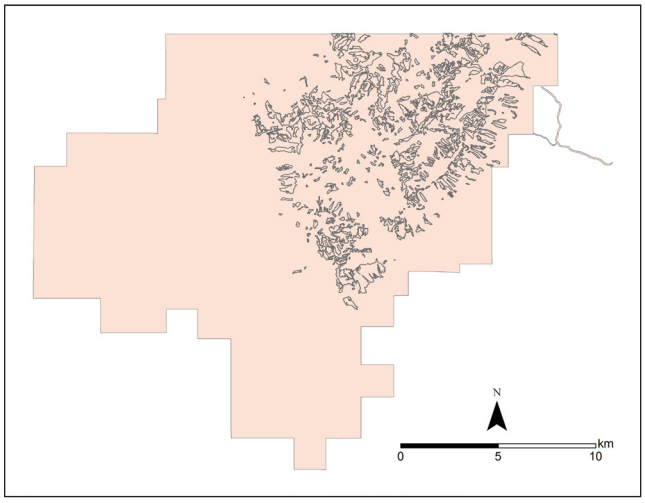


Figure D37. Distribution

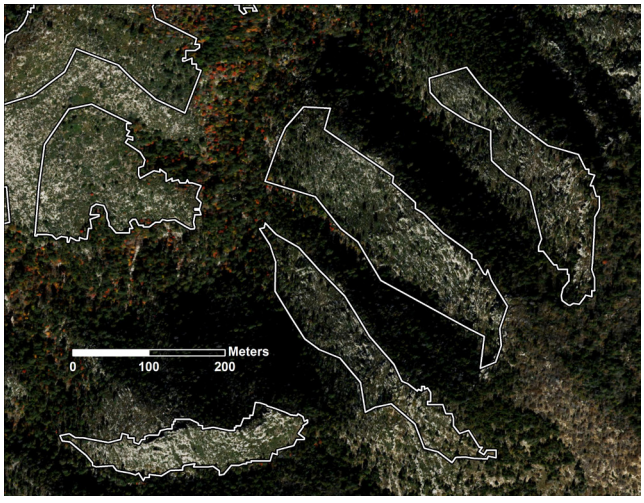


Figure D39. Photo Map Detail

6C Mountain Mahogany Shrubland

Area: 2,349 Ha; 5,805 Acres
Polygons: 172

Primary Component Associations
Cercocarpus montanus / *Muhlenbergia pauciflora* Shrubland

Secondary Component Associations
Cercocarpus montanus / *Muhlenbergia setifolia* Shrubland
Rockland

Summary
In this shrubland, shaggy mountain mahogany can form dense stands along with scattered Parry's agave, green sotol, or Texas sacahuista; wavyleaf oak or pungent oak may be present but clearly subordinate. Sites can be sparse to moderately grassy where New Mexico muhly, curlyleaf muhly, bullgrass, pine muhly, pinyon ricegrass, or little awn needlegrass are diagnostic.

These are extensive shrublands throughout most of the mountain zone of the park. They tend to occur at mid-elevation rocky sites on ridge-tops, moderate to very steep slopes, and limestone escarpments (Figures D40–D42). Commonly, these are successional shrublands following fire in pinyon-juniper woodlands or dry ponderosa pine forests, and conifer regeneration may be present. The shrublands become more persistent with repeated fire, particularly on drier, warmer sites.



Figure D41. Elev.: 4,686 to 8,614 ft (1,428 to 2,626 m)

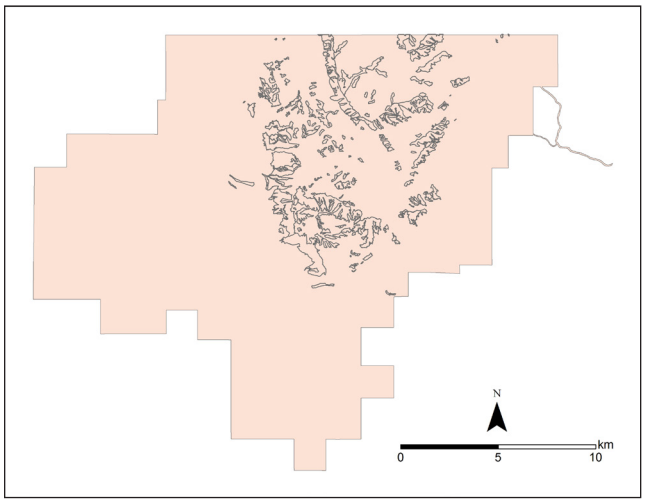


Figure D40. Distribution

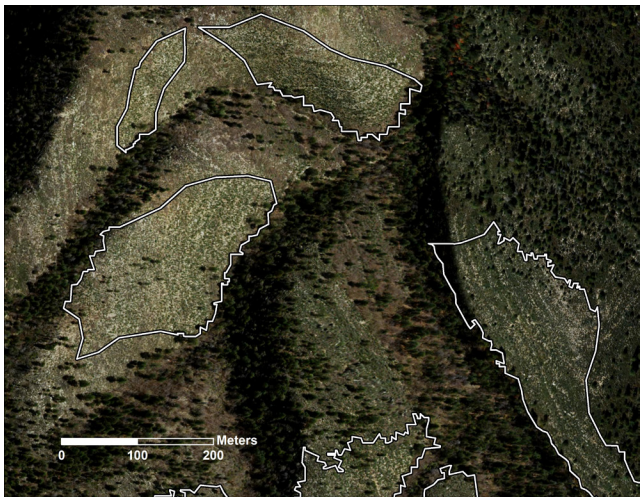


Figure D42. Photo Map Detail

6D Pungent Oak / Bull Muhly Foothill Shrubland and Grassland

Area: 947.4 Ha; 2,341 Acres
Polygons: 64

Primary Component Associations
Quercus (pungens, × pauciloba) / Muhlenbergia emersleyi Shrubland

Inclusion Component Associations
Quercus pungens / Bouteloua gracilis Shrubland
Rockland

Summary
This shrubland is characterized by open stands of wavyleaf oak or pungent oak along with skeletonleaf goldeneye, green sotol, catclaw mimosa, cactus apple, or Texas sacahuista. Intershrub spaces are grassy, and bull grass is diagnostic along with a range of plains grasses such as blue grama, sideoats grama, and plains lovegrass. Forbs can be diverse but relatively low in cover with upwards of 40 species reported.

Sites tend to be at relatively lower elevations where junipers and other trees are uncommon and mixed shrub and grass sites are likely maintained by repeated fire (Figures D43–D45).



Figure D44. Elev.: 5,043 to 7,552 ft (1,537 to 2,302 m)

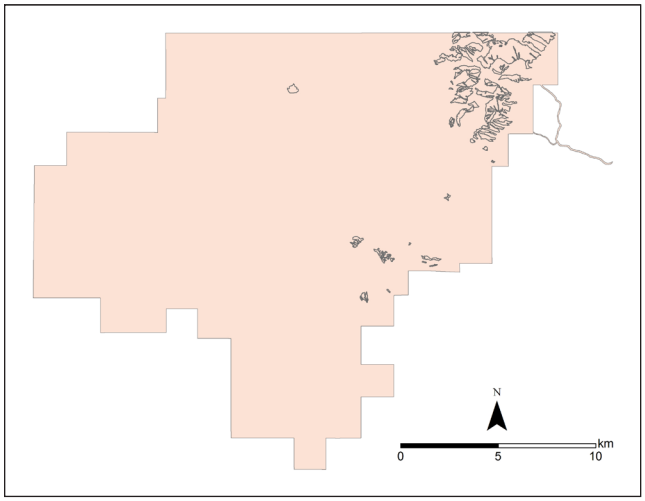


Figure D43. Distribution

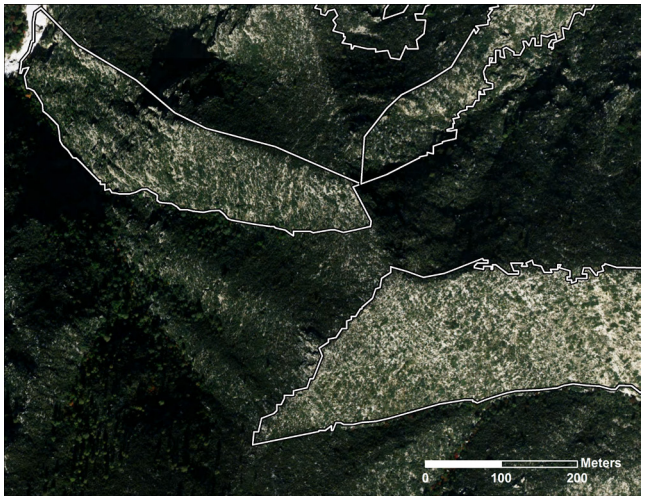


Figure D45. Photo Map Detail

7 Chihuahuan Desert Foothill - Piedmont & Lower Montane Grassland

7A Arizona Fescue - New Mexico Muhly Montane Grassland

Area: 14.83 Ha; 36.63 Acres
Polygons: 7

Primary Component Associations
Festuca arizonica - Bouteloua gracilis Grassland

Summary
These montane grasslands are dominated by the cool-season grass Arizona fescue along with blue grama and big bluestem.

They are restricted to the highest elevations of the mountain zone of the park (Figures D46–D48). They may be a successional community following fire of Douglas-fir and pine forests or persist as glades in the forest matrix.



Figure D47. Elev.: 7,009 to 8,210 ft (2,136 to 2,502 m)

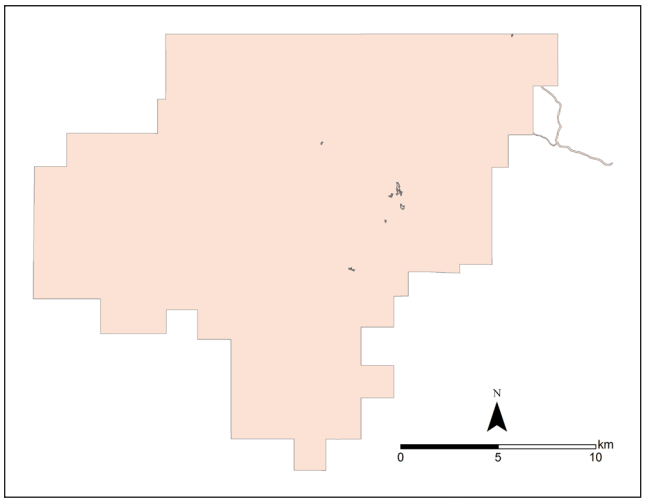


Figure D46. Distribution

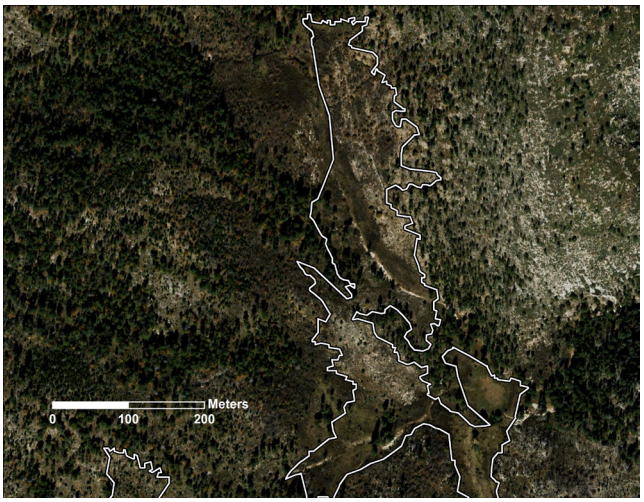


Figure D48. Photo Map Detail

7B Needlegrass Foothill Grasslands

Area: 75.21 Ha; 185.9 Acres
Polygons: 36

Primary Component Associations
Achnatherum lobatum - Bouteloua curtipendula Grassland

Secondary Component Associations
Hesperostipa neomexicana - Bouteloua curtipendula Grassland

Summary
These lower montane-foothill grasslands are dominated by the cool-season grasses little awn needlegrass and New Mexico needlegrass along with a variety warm-season species such as sideoats grama, plains lovegrass, and threeawn. Common forbs include hawkweed buckwheat, Chihuahuan flax, Kunth's onion, bluebowls, and needleleaf bluet. Scattered shrubs such as shaggy mountain mahogany, Texas sacahuista, and green sotol can present but not prominent.

This grassland is restricted to the foothills in the north-central region of the park (Dog Canyon area). Sites can range from gentle rolling hills to steep mountain slopes of northern exposure (Figures D49–D51).



Figure D50. Elev.: 5,164 to 7,058 ft (1,574 to 2,151 m)

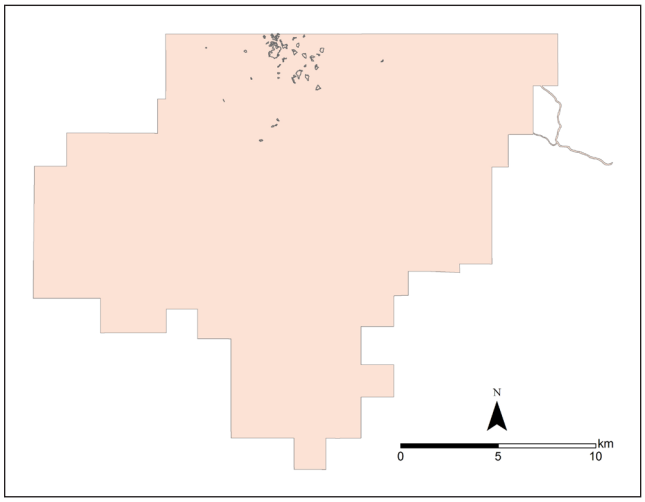


Figure D49. Distribution

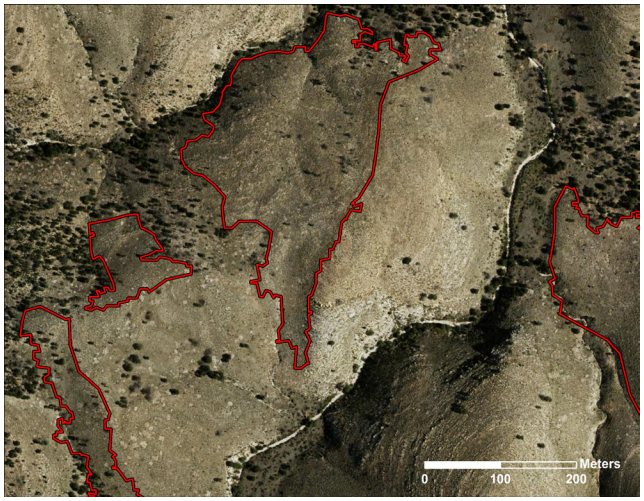


Figure D51. Photo Map Detail

7C Finestem Needlegrass - Blue Grama Valley Grassland

Area: 132.1 Ha; 326.4 Acres
Polygons: 37

Primary Component Associations
Nassella tenuissima - Bouteloua gracilis Grassland

Secondary Component Associations
Bouteloua gracilis - Panicum obtusum Grassland
Bouteloua gracilis - Bouteloua curtipendula Grassland
Bouteloua hirsuta - Bouteloua curtipendula Grassland

Summary
These lower montane-foothill grasslands are dominated by finestem needlegrass and grama grasses (blue, hairy, and sideoats) in a mix of grass and forb species (75+ species recoded among the plant associations). Shrubs other than tree cholla, tulip pricklypear, and broom snakeweed tend be inconspicuous.

This grassland is restricted mostly to valley bottoms and immediate hill slopes in the north-central region of the park (Dog Canyon and Brokeoff Mountains; Figures D52–D54).



Figure D53. Elev.: 4,675 to 6,894 ft (1,425 to 2,101 m)

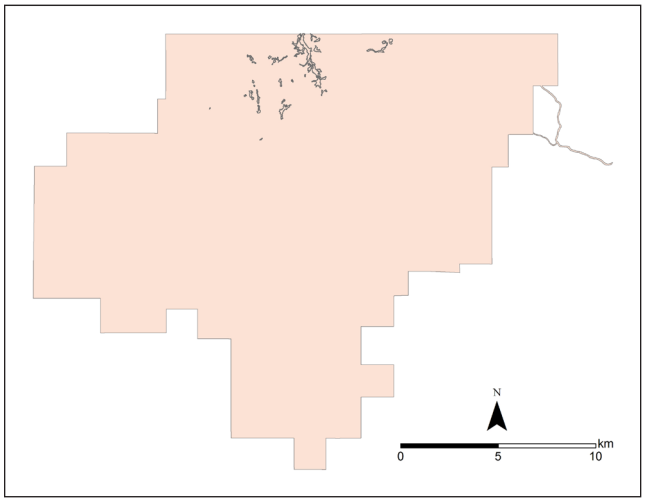


Figure D52. Distribution

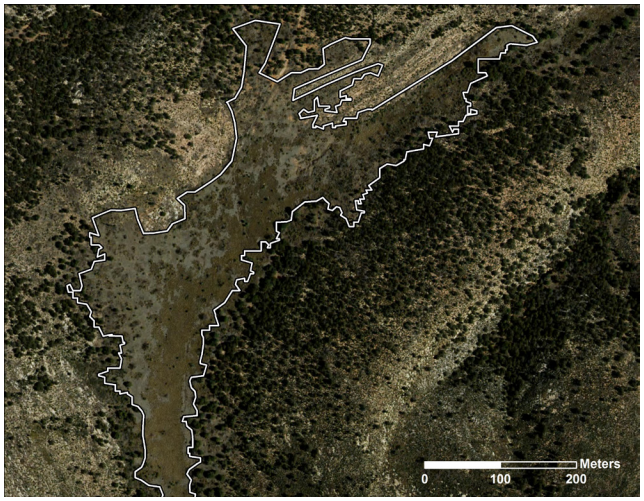


Figure D54. Photo Map Detail

7D Curlyleaf Muhly Foothill Semi-Desert Grassland

Area: 1273 Ha; 3,145 Acres
Polygons: 116

Primary Component Associations
Dasylirion leiophyllum / *Muhlenbergia setifolia* Shrub Grassland
Nolina (texana, microcarpa) / *Muhlenbergia setifolia* Shrub Grassland

Secondary Component Associations
Dasylirion leiophyllum - Agave lechuguilla / *Muhlenbergia setifolia* Shrub Grassland

Summary
This semi-desert grassland is dominated by curlyleaf muhly along with other grasses such as plains lovegrass, sideoats grama, bristly wolfstail, and hairy grama. While grass-dominated, these communities have a conspicuous and diverse mix of shrubs and subshrubs that include green sotol, skeletonleaf goldeneye, Texas sacahuista, Parry's agave, mariola, and lechuguilla. Oaks and mountain mahogany are absent or scattered. Forbs are also diverse with over 60 species recorded within the unit.

These naturally diverse (structurally and compositionally) communities occur extensively in both the rolling hills of the Brokeoff Mountains/Dog Canyon area, and in the foothills along the eastern escarpment of the Guadalupe Mountains (Figures D55–D57).



Figure D56. Elev.: 4,424 to 7,250 ft (1,348 to 2,210 m)

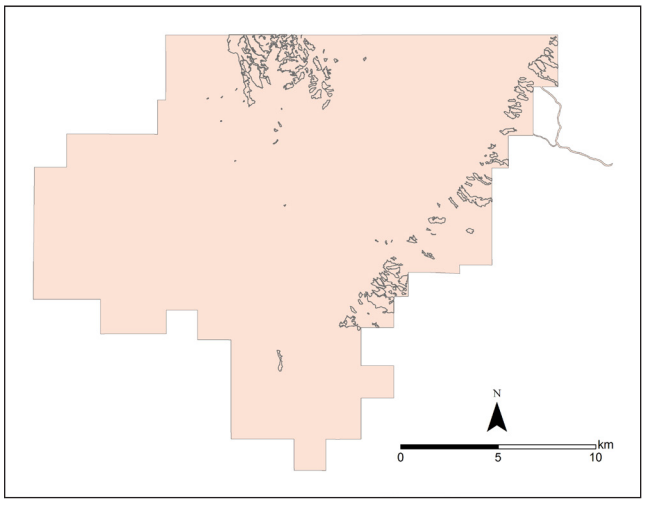


Figure D55. Distribution

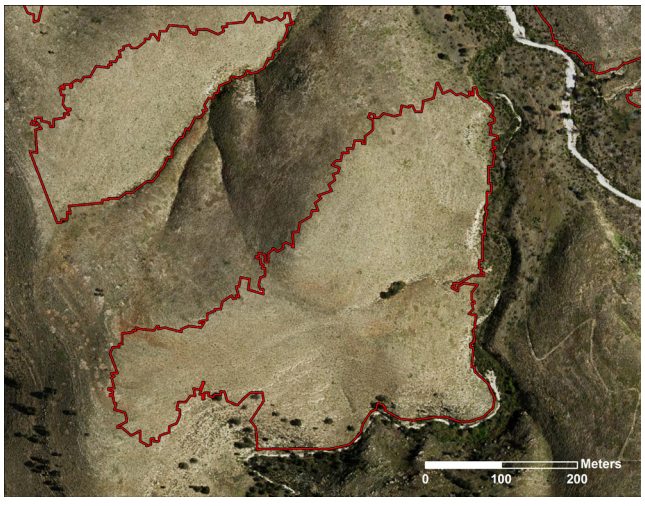


Figure D57. Photo Map Detail

7E Green Sotol - Sacahuista Foothill Semi-Desert Grassland

Area: 1,508 Ha; 3,727 Acres
Polygons: 174

Primary Component Associations
Dasylirion leiophyllum / *Muhlenbergia emersleyi* Shrub Grassland
Dasylirion leiophyllum / *Bouteloua curtipendula* Shrub Grassland
Hesperostipa neomexicana - Dasylirion wheeleri Grassland

Secondary Component Associations
Nolina (texana, microcarpa) / *Muhlenbergia emersleyi* Shrub Grassland
Nolina (texana, microcarpa) / *Bouteloua eriopoda* Shrub Grassland
Viguiera stenoloba / *Muhlenbergia pauciflora* Shrub Grassland

Summary
This semi-desert grassland is dominated by a mix of grasses such as bullgrass, plains lovegrass, sideoats grama, and New Mexico muhly, among others. While grass-dominated, these communities have a conspicuous rosetophilous shrub element represented by green sotol and Texas sacahuista along with a mix of other shrubs and subshrubs. Oaks and mountain mahogany are absent or scattered. Forbs are also diverse, with over 60 species recorded within the unit.

These naturally diverse (structurally and compositionally) communities occur extensively along the foothills of the western escarpment of the Guadalupe Mountains and on foothill slopes in the Dog Canyon area. Sites are typically steep (>40%) and rocky with westerly aspects (Figures D58–D60).



Figure D59. Elev.: 3,863 to 7,226 ft (1,177 to 2,202 m)

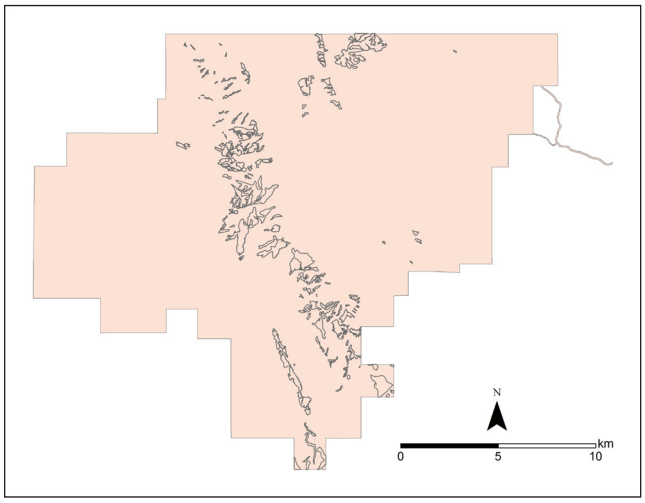


Figure D58. Distribution

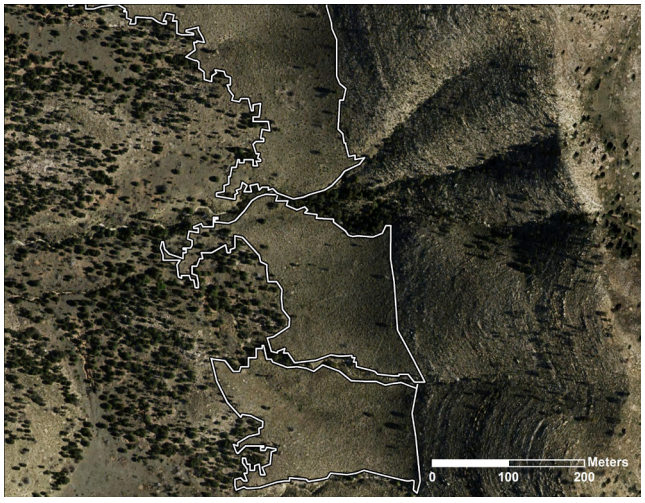


Figure D60. Photo Map Detail

7F Skeletonleaf Goldeneye - Mariola / Grama Grass Foothill Semi-Desert Grassland

Area: 2,952 Ha; 7,295 Acres
Polygons: 210

Primary Component Associations
Viguiera stenoloba / *Bouteloua curtipendula* Shrub Grassland
Viguiera stenoloba / *Bouteloua eriopoda* Shrub Grassland
Viguieria stenoloba / *Bouteloua gracilis* Shrub Grassland
Parthenium incanum / *Bouteloua eriopoda* Shrub Grassland

Secondary Component Associations
Fouquieria splendens / *Bouteloua curtipendula* Shrub Grassland
Fouquieria splendens / *Bouteloua eriopoda* Shrub Grassland

Summary
This semi-desert grassland is dominated by grama grasses (sideoats, blue, and black) among others. While grass-dominated, these communities have a conspicuous shrub element represented by skeletonleaf goldeneye, ocotillo, green sotol, mariola, and Torrey's yucca along with a mix of other shrubs and subshrubs. Oaks and mountain mahogany are absent or scattered. Forbs are also diverse, with over 60 species recorded within the unit.

These naturally diverse (structurally and compositionally) communities occur extensively along the western and eastern escarpments of the Guadalupe Mountains. Sites are typically steep (>40%) and rocky with westerly aspects (Figures D61–D63).



Figure D62. Elev.: 3,789 to 7,996 ft (1,155 to 2,437 m)

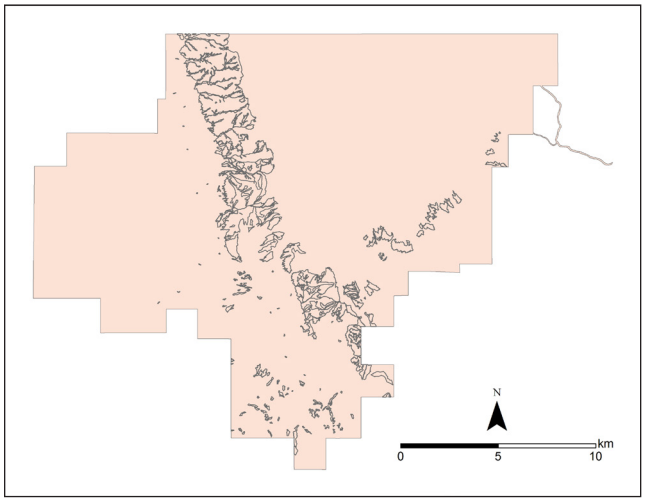


Figure D61. Distribution

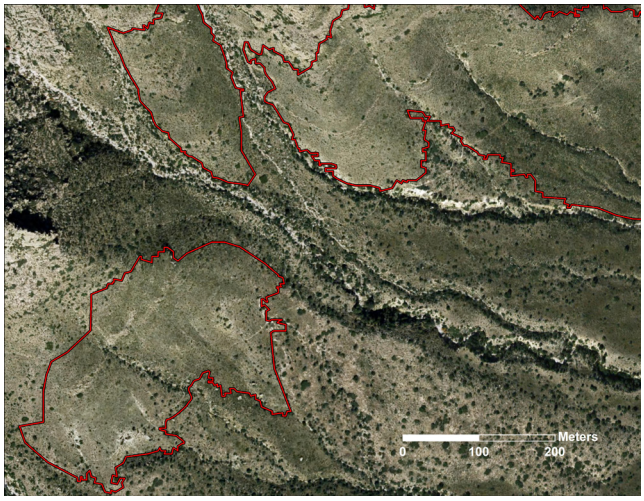


Figure D63. Photo Map Detail

7G Grama Grass Piedmont Grasslands with Pinchot's Juniper or Littleleaf Sumac

Area: 185.8 Ha; 459.1 Acres
Polygons: 60

Primary Component Associations

Bouteloua gracilis - Bouteloua curtipendula Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases
Bo*uteloua eriopoda - Bouteloua gracilis* Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases

Secondary Component Associations

Yucca elata / *Bouteloua eriopoda* Shrub Grassland, *Juniperus pinchotii* or *Rhus microcephala* phases

Summary

This semi-desert grassland is dominated by grama grasses (sideoats, blue, hairy, and black) among others along with a conspicuous shrub element of Pinchot's juniper or occasionally littleleaf sumac and honey mesquite. Oaks and mountain mahogany are absent or scattered. Forbs are also diverse, with over 70 species recorded within the unit.

These grasslands are limited to the alluvial fan piedmonts extending out from the eastern escarpment of the Guadalupe Mountains. Slopes tend to be gentle (<10%) and southeasterly in aspect (Figures D64–D66).



Figure D65. Elev.: 5,081 to 6,296 ft (1,549 to 1,919 m)

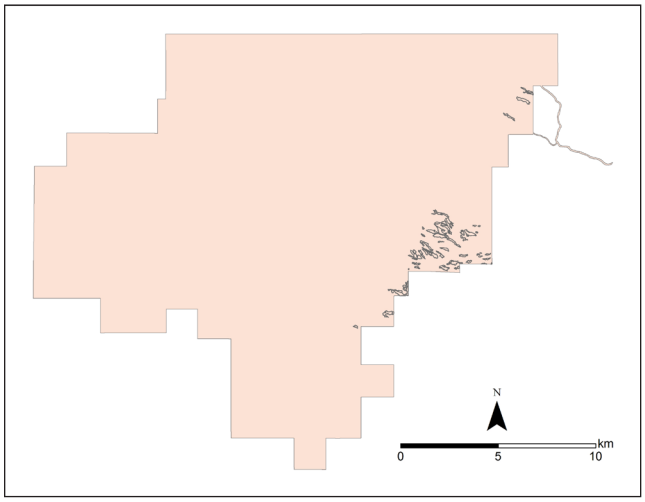


Figure D64. Distribution

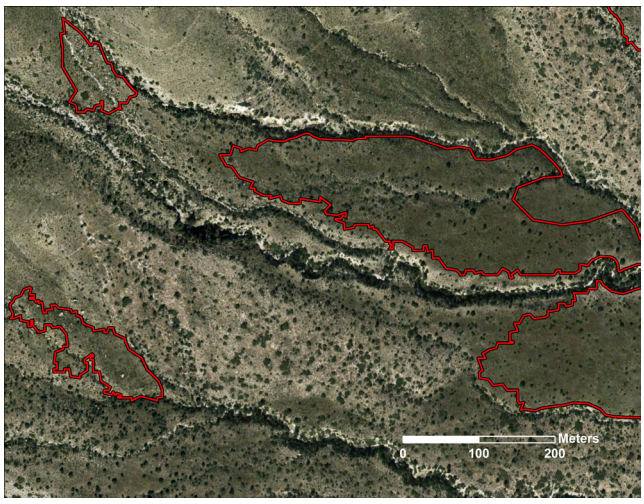


Figure D66. Photo Map Detail

7H Grama Grass Piedmont Grassland

Area: 221.1 Ha; 546.3 Acres
Polygons: 56

Primary Component Associations
Bouteloua eriopoda - Bouteloua gracilis Grassland
Yucca elata / Bouteloua eriopoda - Bouteloua gracilis Shrub Grassland
Yucca elata / Bouteloua eriopoda Shrub Grassland

Secondary Component Associations
Muhlenbergia setifolia - Bouteloua eriopoda Grassland
Bouteloua eriopoda - Hesperostipa neomexicana Grassland
Yucca elata / Bouteloua gracilis Shrub Grassland

Summary
This semi-desert grassland is dominated by grama grasses (sideoats, blue, hairy, and black) along with scattered soaptree yucca and skeletonleaf goldeneye as characteristic shrubs. Pinchot's juniper, littleleaf sumac, or honey mesquite along with oaks and mountain mahogany are absent or scattered. Forbs are also diverse, with over 70 species recorded within the unit.

These grasslands are limited to the alluvial fan piedmonts extending out from the eastern escarpment of the Guadalupe Mountains with isolated occurrences in the Brokeoff Mountains. Slopes tend to be gentle (<10%) and southeasterly in aspect (Figures D67–D69).



Figure D68. Elev.: 4,542 to 7,529 ft (1,384 to 2,295 m)

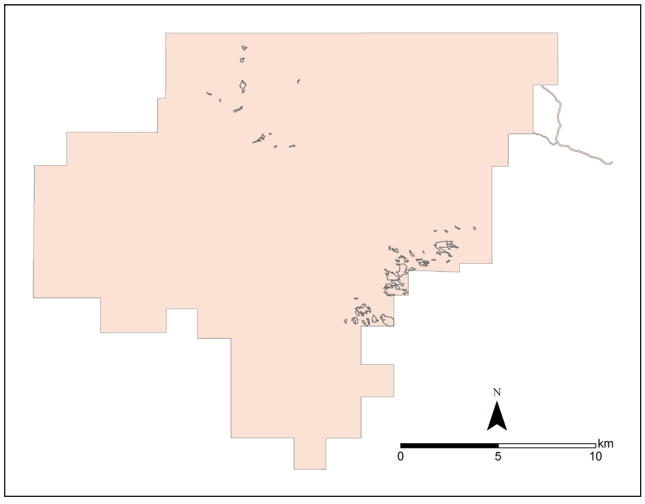


Figure D67. Distribution

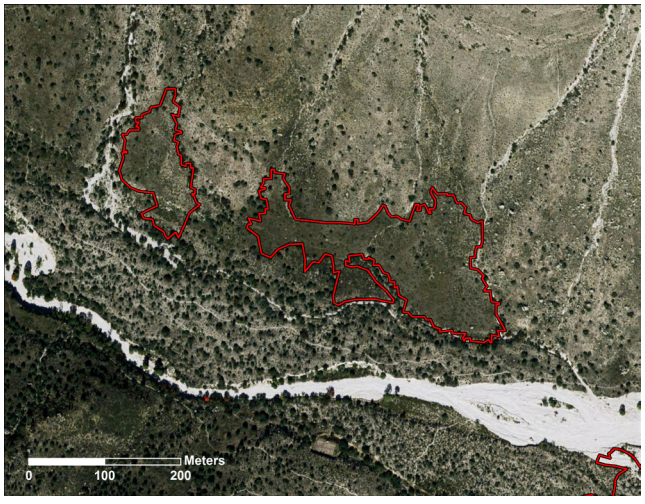


Figure D69. Photo Map Detail

7I Black Grama - Mixed Grasses Piedmont Semi-Desert Grassland

Area: 810.2 Ha; 2,002 Acres
Polygons: 235

Primary Component Associations
Bouteloua eriopoda - Muhlenbergia porteri Grassland
Bouteloua eriopoda - Bouteloua curtipendula Grassland
Yucca torreyi / *Bouteloua eriopoda* Shrub Grassland

Secondary Component Associations
Agave lechuguilla / *Bouteloua eriopoda* Dwarf-shrubland
Tiquilia hispidissima / *Dasyochloa pulchella* Dwarf-shrub Grassland
Krameria grayi / *Dasyochloa pulchella* Dwarf-shrub Grassland

Summary
This semi-desert grassland is dominated by black grama, sideoats grama, and fluffgrass with a mix of desert subshrubs such as white ratany, mariola, and hairy crinklemat. Scattered tall shrubs also occur such as creosotebush, ocotillo, Torrey's yucca, and soaptree yucca. Forbs are also diverse, with over 40 species recorded within the unit.

These grasslands are common on the alluvial fan piedmonts and foothills extending out from the western escarpment of the Guadalupe and Brokeoff mountains. Slopes tend to be gentle to moderate (up to 20%) and southerly aspect (Figures D70–D72).



Figure D71. Elev.: 3,689 to 8,295 ft (1,124 to 2,528 m)

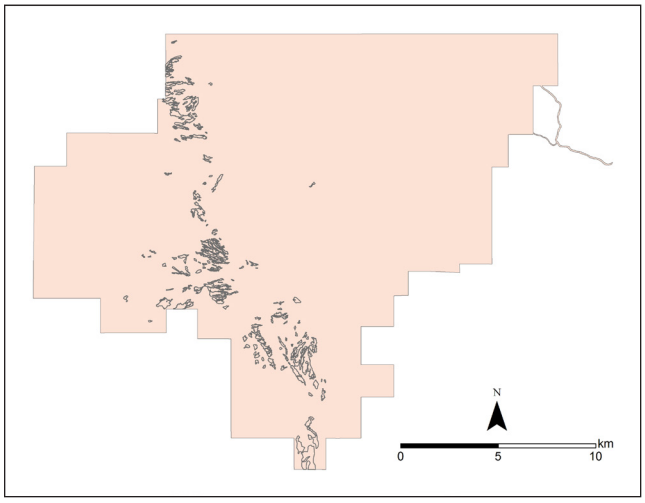


Figure D70. Distribution

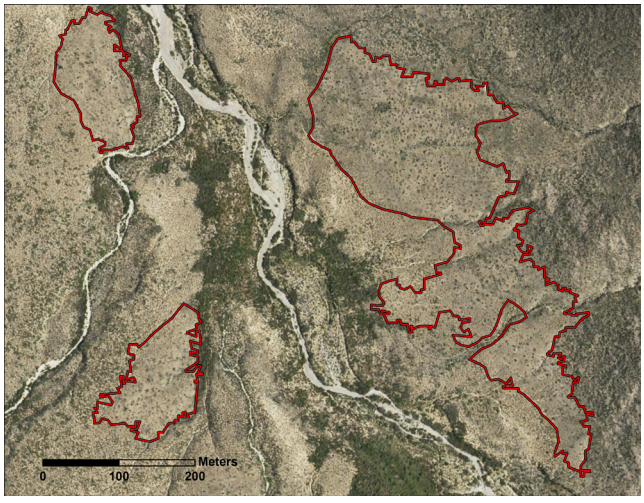


Figure D72. Photo Map Detail

7J Catclaw Mimosa / Sideoats Grama Semi-Desert Grassland

Area: 328.9 Ha; 812.6 Acres
Polygons: 114

Primary Component Associations
Mimosa aculeaticarpa var. *biuncifera* / *Bouteloua curtipendula* Shrub Grassland

Summary
This semi-desert grassland is dominated by sideoats grama, blue grama, or plains lovegrass. While dominated by grasses, catclaw mimosa is commonly well represented to abundant in the shrub layer along with a suite of other shrubs and subshrubs. Forbs are also diverse, with over 40 species recorded within the unit.

These grasslands are limited to the alluvial terraces, piedmonts, and footslopes extending out from the eastern escarpment of the Guadalupe Mountains. Slopes tend to be gentle (< 10%) and southeasterly in aspect (Figures D73–D75).



Figure D74. Elev.: 5,014 to 7,987 ft (1,528 to 2,435 m)

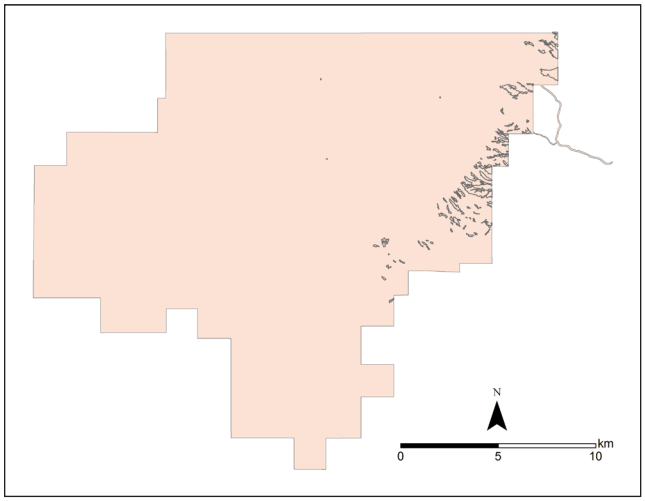


Figure D73. Distribution

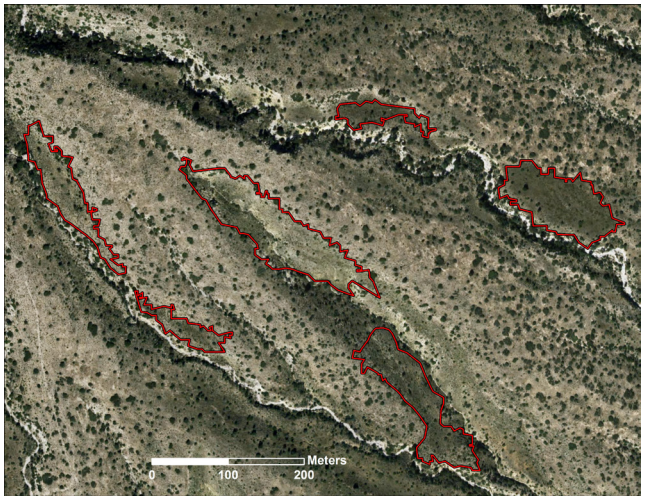


Figure D75. Photo Map Detail

8 Chihuahuan Gypsophilous Grassland

8A Gypsum Dune Semi-Desert Grassland

Area: 220.2 Ha; 544.1 Acres
Polygons: 36

Primary Component Associations
Ephedra torreyana / *Bouteloua breviseta* Dwarf-shrub Grassland

Secondary Component Associations
Tiquilia hispidissima / *Bouteloua breviseta* - *Sporobolus nealleyi* Shrub Grassland

Summary
These gypsum grassland communities are dominated by gypsum grama and gypsum dropseed in association with Torrey's jointfir and hairy crinklemat as common shrub elements. Forbs are also represented by gypsophiles such as threadleaf glowwort, gypsum moonpod, Guadalupe blazingstar, gypsum scorpionweed, and gypsum blanketflower.

These communities are limited to the gypsum region on the western edge of the park where they occur in interdune sandsheets and low dune areas (Figures D76–D78).



Figure D77. Elev.: 3,625 to 3,702 ft (1,105 to 1,128 m)

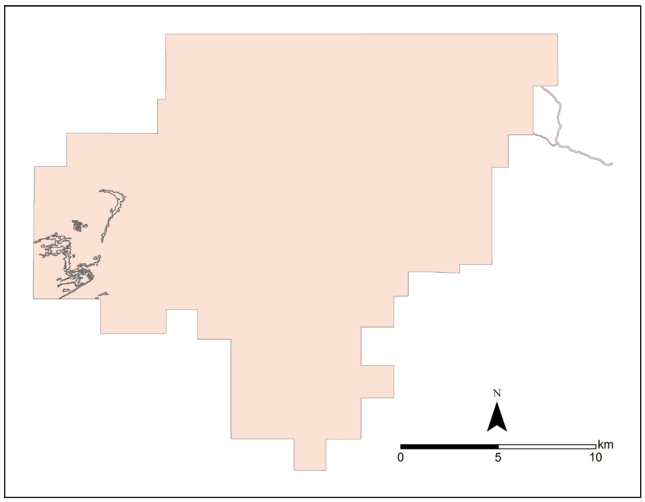


Figure D76. Distribution

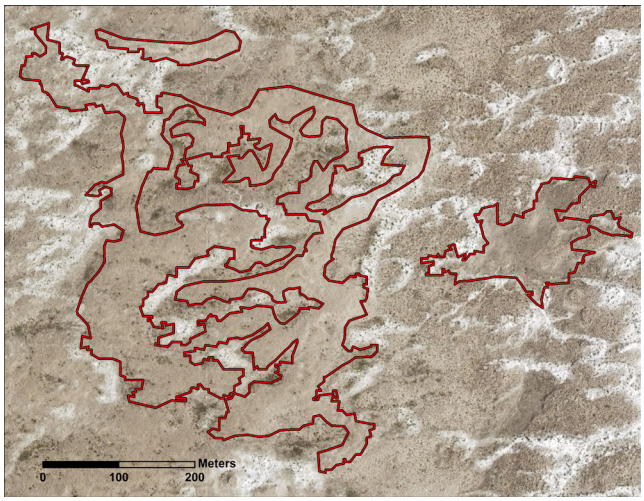


Figure D78. Photo Map Detail

8B Gypsum Flat Dropseed Grassland

Area: 255.8 Ha; 632.1 Acres
Polygons: 117

Primary Component Associations
Sporobolus nealleyi - Sporobolus airoides Grassland

Secondary Component Associations
Sporobolus airoides Monotype Wet Meadow

Summary
These gypsum grassland communities are dominated by gypsum dropseed and alkali sacaton along with the subshrub hairy crinklemat and other scattered forb gypsophiles such as threadleaf glowwort, gypsum moonpod, Guadalupe blazingstar, gypsum scorpionweed, and gypsum blanketflower.

These communities are limited to the gypsum region on the western edge of the park where they occur on wind-scoured gypsum flats and in interdune spaces (Figures D79–D81).



Figure D80. Elev.: 3,615 to 3,784 ft (1,102 to 1,154 m)

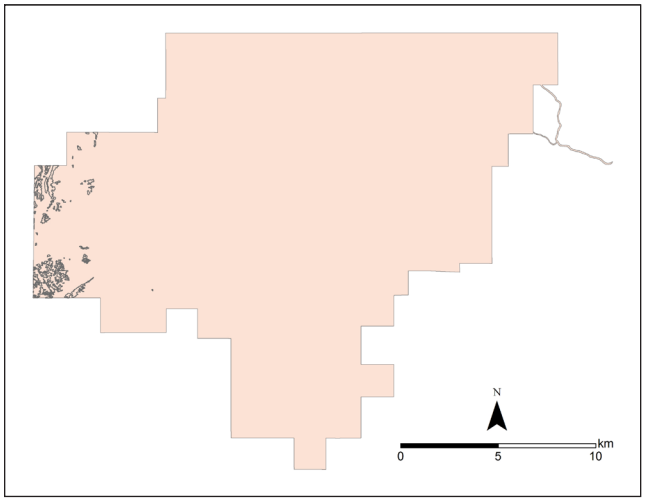


Figure D79. Distribution

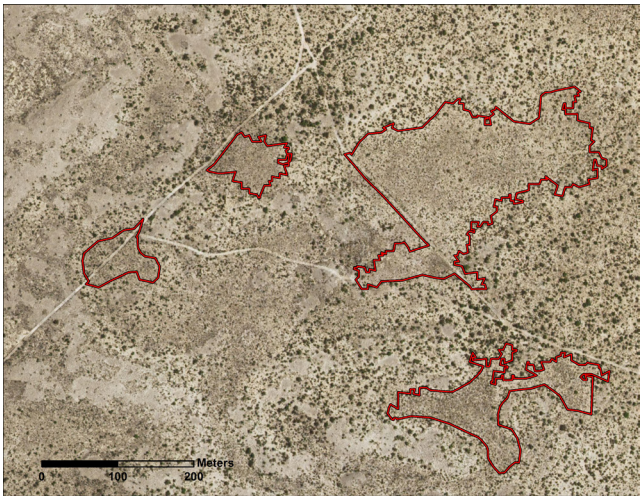


Figure D81. Photo Map Detail

8C Gypsum Flat Semi-desert Grassland

Area: 772.0 Ha; 1,908 Acres
Polygons: 335

Primary Component Associations
Tiquilia hispidissima / *Sporobolus nealleyi* Dwarf-shrubland

Secondary Component Associations
Tiquilia hispidissima / *Sartwellia flaveriae* Dwarf-shrubland

Summary
These gypsum grassland communities are dominated by gypsum dropseed along with the subshrub hairy crinklemat and other scattered forb gypsophiles such as threadleaf glowwort, gypsum moonpod, Guadalupe blazingstar, gypsum scorpionweed, and gypsum blanketflower.

These communities are limited to the gypsum region on the western edge of the park where they occur on wind-scoured gypsum flats and in interdune spaces (Figures D82–D84).



Figure D83. Elev.: 3,619 to 3,746 ft (1,103 to 1,142 m)

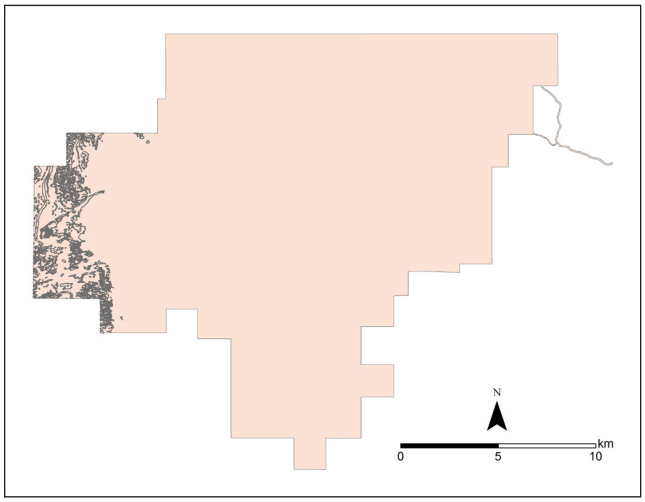


Figure D82. Distribution

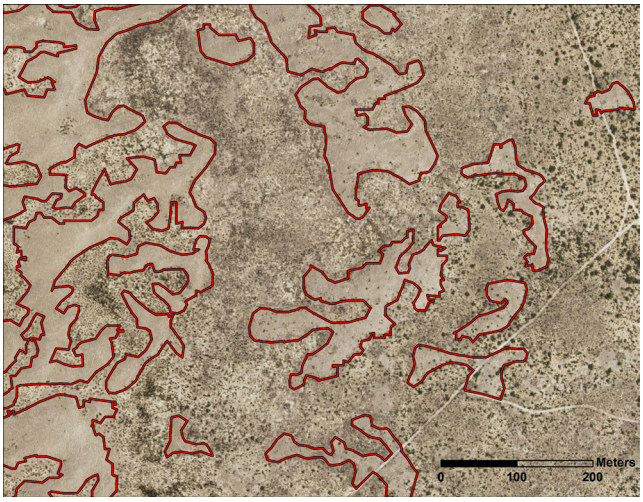


Figure D84. Photo Map Detail

9 Chihuahuan Gypsophilous Scrub

9A Frosted Mint Gypsum Dune Desert Scrub

Area: 503.5 Ha; 1,244 Acres
Polygons: 64

Primary Component Associations

Poliomintha incana / *Andropogon hallii* Shrubland
Poliomintha incana / *Bouteloua breviseta* Gypsophilous Shrubland
Poliomintha incana / *Sporobolus flexuosus* Shrubland

Summary

These gypsum shrublands are dominated by frosted mint along with occasional broom dalea, fourwing saltbush, and soaptree yucca. Grasses are scattered within and among the shrubs with and are represented by gypsum grama, sand bluestem, mesa dropseed, Indian ricegrass, and giant dropseed. Forbs are characterized by gypsophiles such as Guadalupe blazingstar, gypsum scorpionweed, gypsum moonpod, and gypsum blanketflower.

These communities are limited to the gypsum dunefield on the western edge of the park where they occur on the leading edges of the taller dunes (Figures D85–D87).



Figure D86. Elev.: 3,629 to 3,725 ft (1,106 to 1,135 m)

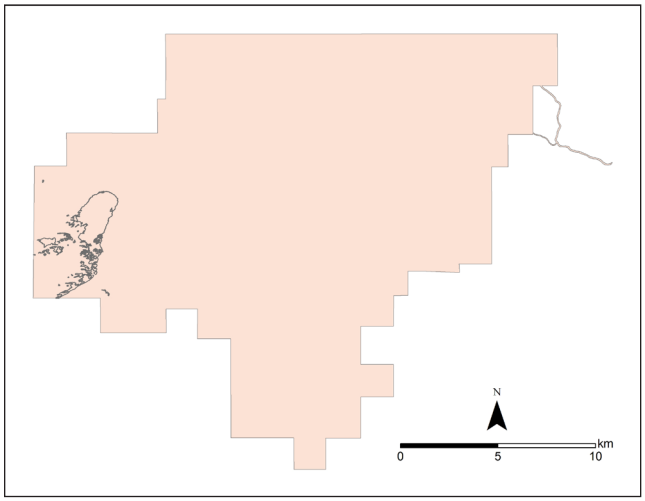


Figure D85. Distribution

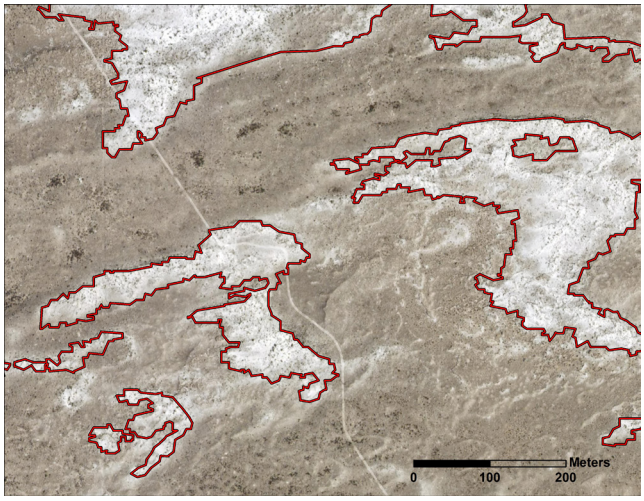


Figure D87. Photo Map Detail

9B Fourwing Saltbush Gypsum Desert Scrub

Area: 1,324 Ha; 3,272 Acres
Polygons: 286

Primary Component Associations
Atriplex canescens / *Sporobolus airoides* / *Sartwellia flaveriae* Shrubland
Atriplex canescens / *Muhlenbergia porteri* - *Sartwellia flaveriae* Shrubland

Secondary Component Associations
Atriplex canescens / *Sporobolus nealleyi* Shrubland
Sporobolus airoides Monotype Wet Meadow

Summary
These gypsum shrubland communities are dominated by fourwing saltbush with the grasses bush muhly and alkali sacaton often abundant in the shrub and intershrub spaces. The subshrub hairy crinklemat and scattered forb gypsophiles may be present and include threadleaf glowwort, gypsum moonpod, and gypsum blanketflower.

These communities are limited to the gypsum region on the western edge of the park where they occur on wind-scoured gypsum flats and in interdune spaces (Figures D88–D90).



Figure D89. Elev.: 3,615 to 3,741 ft (1,102 to 1,140 m)

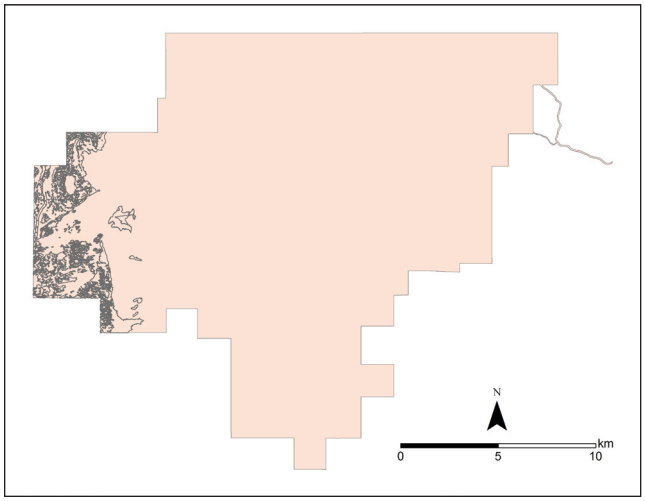


Figure D88. Distribution

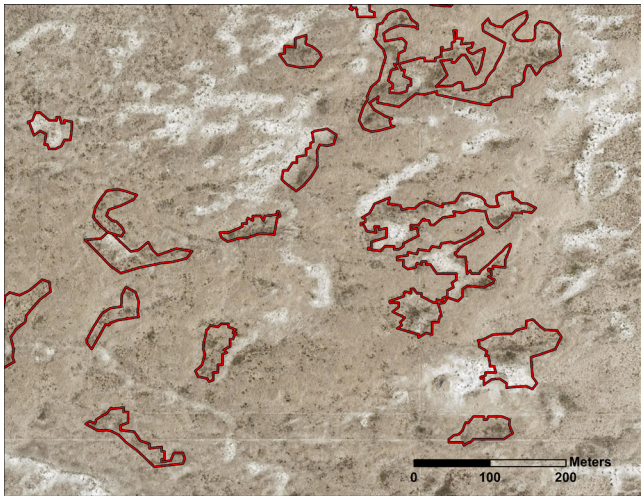


Figure D90. Photo Map Detail

10 Chihuahuan Desert Succulent Scrub

10A Mariola - Goldeneye - Ocotillo Desert Scrub

Area: 2,573 Ha; 6,358 Acres
Polygons: 227

Primary Component Associations
Viguiera stenoloba / *Parthenium incanum* Shrubland
Fouquieria splendens - Tiquilia greggii Shrubland
Fouquieria splendens / *Parthenium incanum* Shrubland

Secondary Component Associations
Mortonia scabrella - Parthenium incanum Shrubland

Summary
Ocotillo and skeletonleaf goldeneye dominate in a diverse mix of other shrubs and subshrubs (50+ species recorded). Cacti alone are represented by 10 species. Shrub cover can be as high as 50%, but grass and forb cover is generally low (< 10%).

Extensive stands occur on alluvial piedmonts and rocky footslopes extending out from the western escarpment of the Guadalupe Mountains and Patterson Hills. Slopes can be very steep (up to 50%; Figures D91–D93).



Figure D92. Elev.: 3,770 to 5,802 ft (1,149 to 1,769 m)

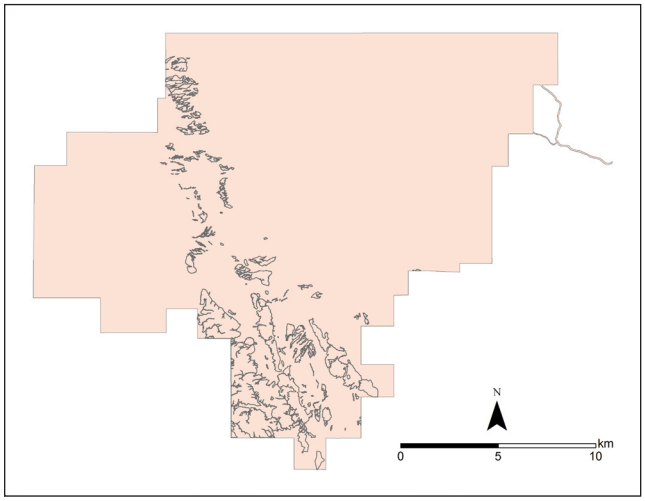


Figure D91. Distribution

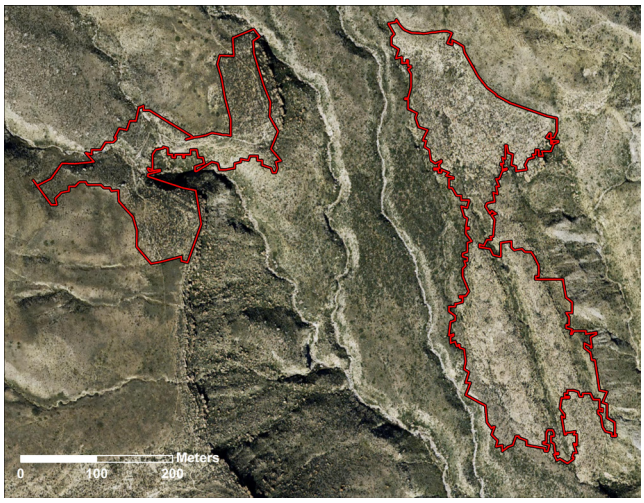


Figure D93. Photo Map Detail

11 Chihuahuan Creosotebush - Mixed Desert Scrub

11A Viscid Acacia Desert Scrub

Area: 366.6 Ha; 905.8 Acres
Polygons: 86

Primary Component Associations
Acacia neovernicosa / *Bouteloua eriopoda* Shrubland

Secondary Component Associations
Acacia neovernicosa - Agave lechuguilla Shrubland

Summary
These shrublands are strongly dominated by viscid acacia with scattered creosotebush and honey mesquite. Subshrubs such as mariola, white ratany, lechuguilla, and broom snakeweed may also be common along with several cactus species. Sites can be grassy to sparse with black grama and sideoats grama sometimes abundant.

Stands are limited to alluvial piedmonts and lower foothill slopes extending out from the western escarpment of the Guadalupe Mountains and in the Patterson Hills. Sites tend to be rocky; slopes range from 15 to 40% and can be very steep (Figures D94–D96).



Figure D95. Elev.: 4,228 to 6,391 ft (1,289 to 1,948 m)

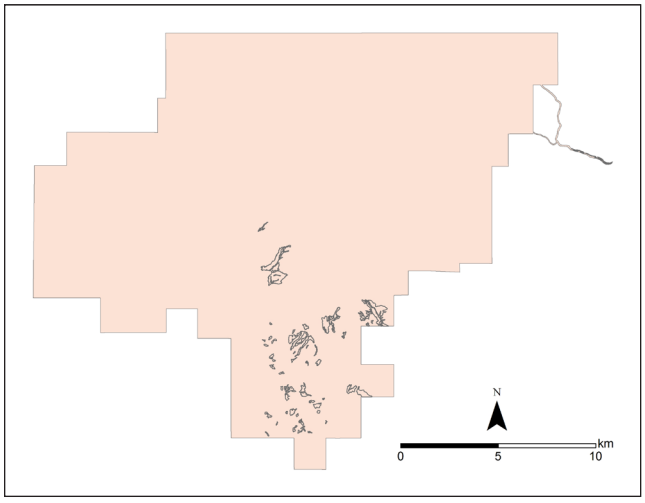


Figure D94. Distribution

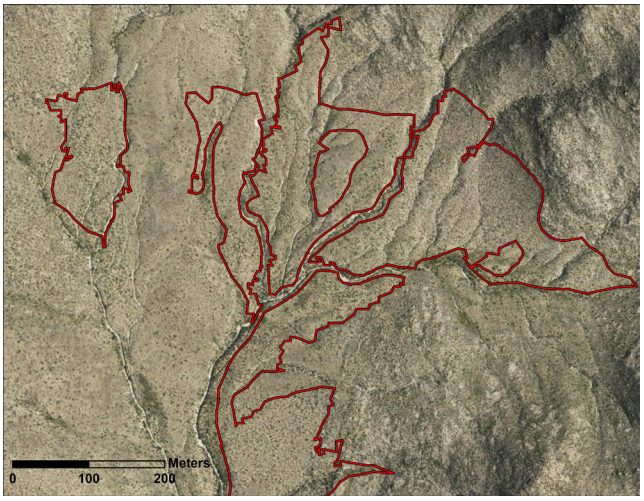


Figure D96. Photo Map Detail

11B Fourwing Saltbush Desert Scrub

Area: 904.4 Ha; 2,235 Acres
Polygons: 22

Primary Component Associations
Atriplex canescens / *Sporobolus airoides* Shrubland

Secondary Component Associations
Atriplex canescens / *Sporobolus (flexuosus, cryptandrus, contractus)* Shrubland
Sporobolus airoides Monotype Wet Meadow

Summary
These shrubland communities are dominated by fourwing saltbush with grassy intershrub spaces dominated by sand dropseed and alkali sacaton. Subshrubs and forbs are scattered and relatively low in diversity.

These communities are common on the floor of the Salt Basin in the western region of the park. They occur on nearly flat, non-gypsum surfaces with silty or clay soils (Figures D97–D99).



Figure D98. Elev.: 3,632 to 3,999 ft (1,107 to 1,219 m)

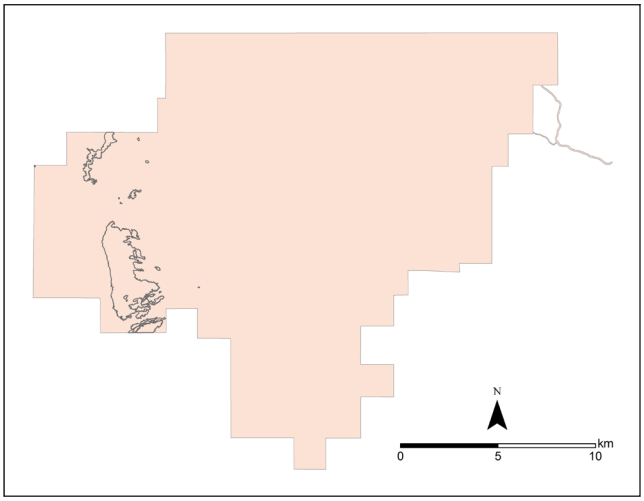


Figure D97. Distribution

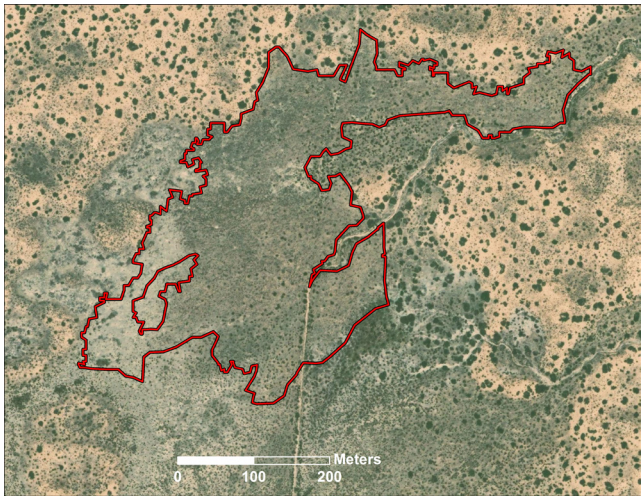


Figure D99. Photo Map Detail

11C Creosotebush Desert Scrub

Area: 2,371 Ha; 5,859 Acres
Polygons: 385

Primary Component Associations
Larrea tridentata / *Bouteloua eriopoda* Shrubland
Larrea tridentata - *Parthenium incanum* Shrubland
Larrea tridentata / Sparse Understory Shrubland

Secondary Component Associations
Larrea tridentata - *Krameria grayi* Shrubland
Larrea tridentata / *Sporobolus flexuosus* Shrubland
Larrea tridentata - *Flourensia cernua* Sparse Shrubland
Larrea tridentata / *Sporobolus airoides* Shrubland

Summary
These shrublands are strongly dominated by creosotebush with tarbush, mariola, white ratany, lechuguilla, and broom snakeweed common associates along with several cactus species (12+ species recorded). Sites can be grassy to sparse with black grama and bush muhly the most prevalent.

Extensive stands are mostly found on alluvial fan piedmonts extending out from the western escarpment of the Guadalupe Mountains and in the Patterson Hills, but they also occasionally occur on lower foothill slopes or basin bottom plains. Sites tend to be gravelly, with slopes below 10% (Figures D100–D103).

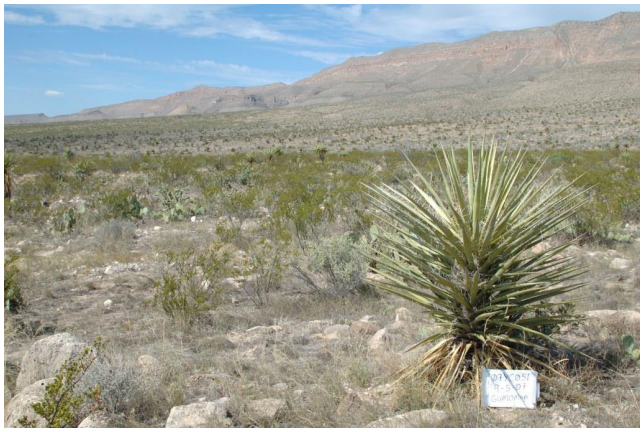


Figure D101. Elev.: 3,642 to 5,918 ft (1,110 to 1,804 m)

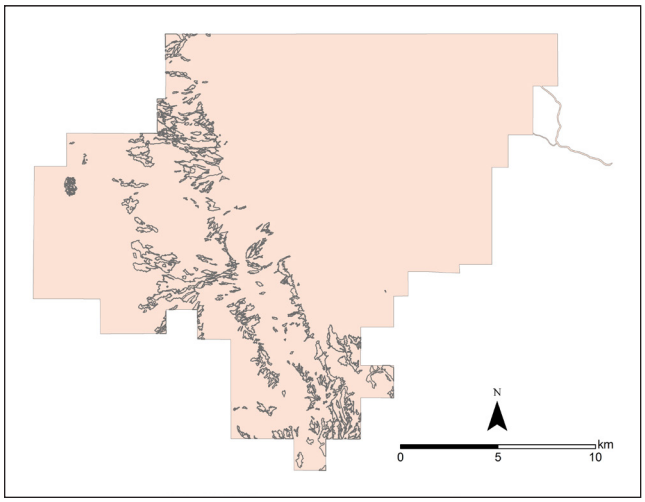


Figure D100. Distribution

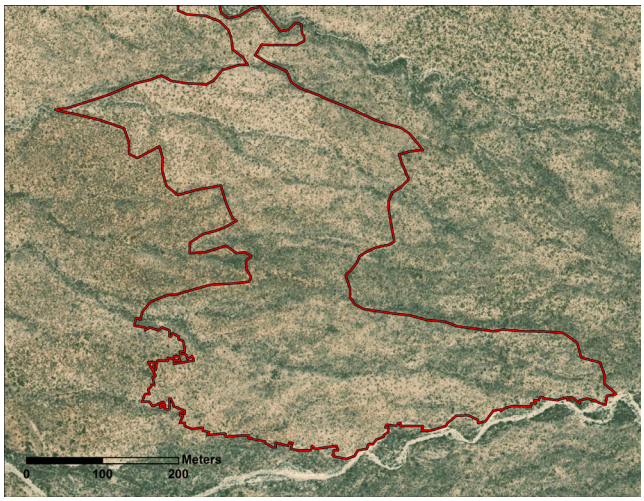


Figure D102. Photo Map Detail

11D Creosotebush Desert Scrub with Honey Mesquite

Area: 1,491 Ha; 3,685 Acres
Polygons: 296

Primary Component Associations

Larrea tridentata / *Bouteloua eriopoda* Shrubland, *Prosopis glandulosa* phase
Larrea tridentata / *Bouteloua gracilis* Shrubland, *Prosopis glandulosa* phase
Larrea tridentata / Sparse Understory Shrubland, *Prosopis glandulosa* phase

Secondary Component Associations

Larrea tridentata / *Muhlenbergia porteri* Shrubland, *Prosopis glandulosa* phase

Summary

These shrublands are codominated by creosotebush and honey mesquite with skeletonleaf goldeneye, mariola, white ratany, lechuguilla, and broom snakeweed as common associates. Sites can be grassy to sparse, with black grama and bush muhly the most prevalent.

Extensive stands are mostly found on alluvial fan piedmonts extending out from the western escarpment of the Guadalupe Mountains and in the Patterson Hills, but they also occasionally occur on lower foothill slopes or basin bottom plains. Sites tend to be gravelly, with slopes below 10% (Figures D103–D105).



Figure D104. Elev.: 3,662 to 5,767 ft (1,116 to 1,758 m)

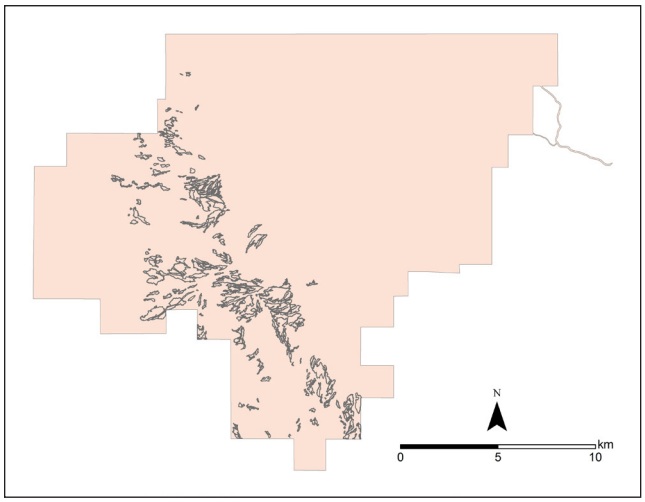


Figure D103. Distribution

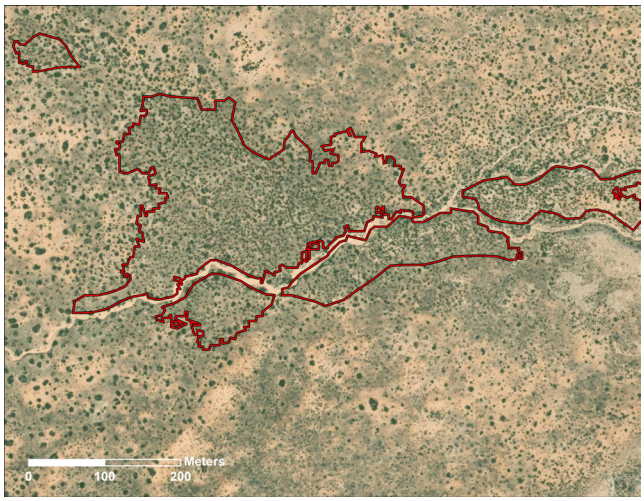


Figure D105. Photo Map Detail

11E Broom Dalea - Honey Mesquite Coppice Dune

Area: 1,871 Ha; 4,624 Acres
Polygons: 47

Primary Component Associations
Prosopis glandulosa / *Sporobolus flexuosus* Ruderal Shrubland

Secondary Component Associations
Psorothamnus scoparius / *Sporobolus flexuosus* Shrubland
Prosopis glandulosa / *Sporobolus airoides* Shrubland

Summary
These coppice dune shrublands are dominated by honey mesquite with occasional fourwing saltbush and other shrubs and subshrubs present. Intershrub spaces tend to be sparse or with scattered sand-tolerant grasses such as mesa dropseed, sand dropseed, giant dropseed, spike dropseed, and Indian ricegrass. Forbs are also low in cover and diversity.

These shrublands occur as an extensive coppice dunefield known as the red dunes in the western region of the park (Figures D106–D108). They are thought to be a function of the historical desertification of sandsheet grasslands and the subsequent invasion of honey mesquites that captures and demobilizes the sands around the shrub bases to form the dunes.



Figure D107. Elev.: 3,640 to 4,169 ft (1,109 to 1,271 m)

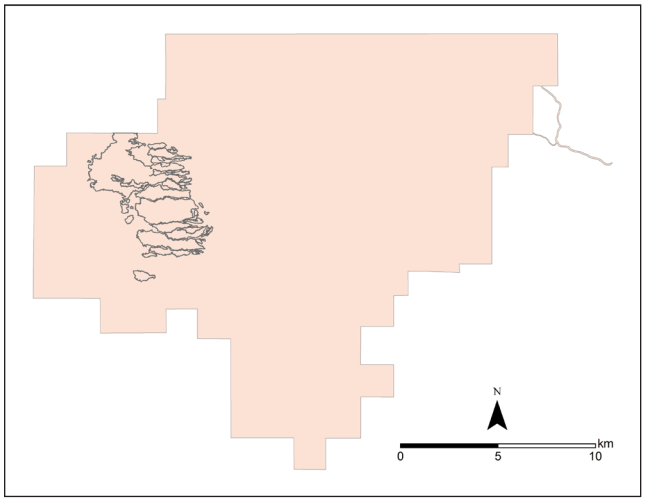


Figure D106. Distribution

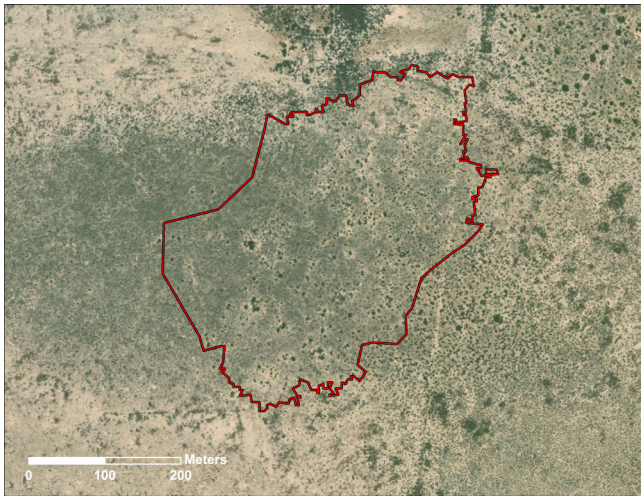


Figure D108. Photo Map Detail

12 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope

12A Mexican Buckeye - Oak Desert Canyon Shrubland

Area: 362.2 Ha; 895.0 Acres
Polygons: 211

Primary Component Associations
Fallugia paradoxa / *Ungnadia speciosa* Shrubland

Secondary Component Associations
Dry Wash

Summary
These shrublands of dry desert canyons are dominated by Apache plume, Mexican buckeye, and evergreen sumac among other shrubs that can tolerate episodic flooding. Grass and forb cover is limited, with sideoats grama the most common species.

These shrublands are common in steep, narrow canyons within and along the escarpments of the Guadalupe Mountains (Figures D109–D111). The canyons usually lack perennial water but are subject to episodic flooding from summer rainstorms.



Figure D110. Elev.: 3,875 to 8,233 ft (1,181 to 2,509 m)

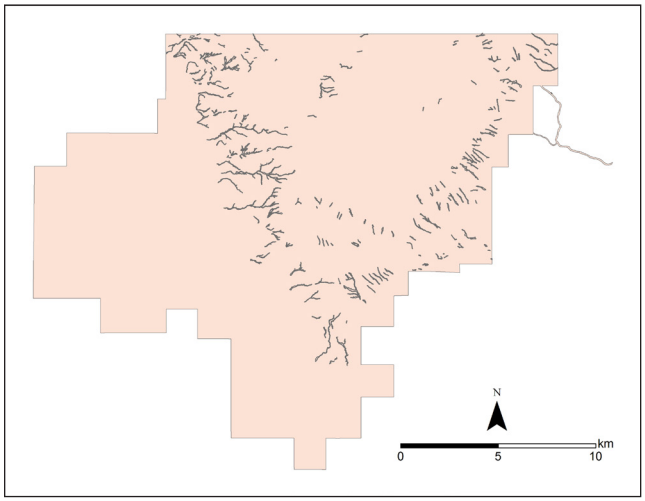


Figure D109. Distribution

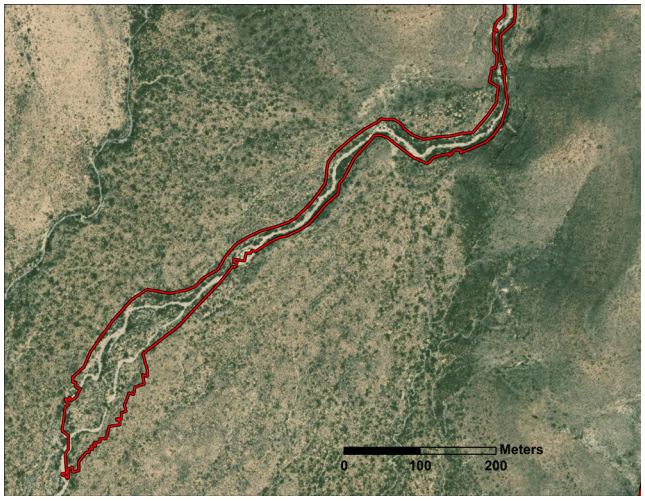


Figure D111. Photo Map Detail

12B Apache Plume - Desert Willow Dry Wash Riparian Shrubland

Area: 363.6 Ha; 898.5 Acres
Polygons: 86

Primary Component Associations
Fallugia paradoxa Desert Wash Shrubland
Fallugia paradoxa - Brickellia laciniata Desert Wash Shrubland

Secondary Component Associations
Juglans microcarpa - Fallugia paradoxa / Bouteloua curtipendula Desert Shrubland
Chilopsis linearis - Fallugia paradoxa Shrubland
Dry Wash

Summary
These shrublands are dominated by Apache plume and desert willow along with a diverse mix of broadleaf trees, shrubs, and subshrubs that include little walnut, splitleaf brickellbush, Wright's beebrush, mariola, and gumhead (60+ shrub species). Grass and forb cover is limited, with sideoats grama and plains lovegrass the most common species.

These shrublands are common in dry desert washes of the wider canyons within and along the escarpments of the Guadalupe Mountains and then extending out as inset channels on the alluvial fan piedmonts (bajadas; Figures D112–D114). The washes lack perennial water but are subject to episodic, often large flooding events during summer rainstorms.



Figure D113. Elev.: 3,723 to 6,238 ft (1,135 to 1,901 m)

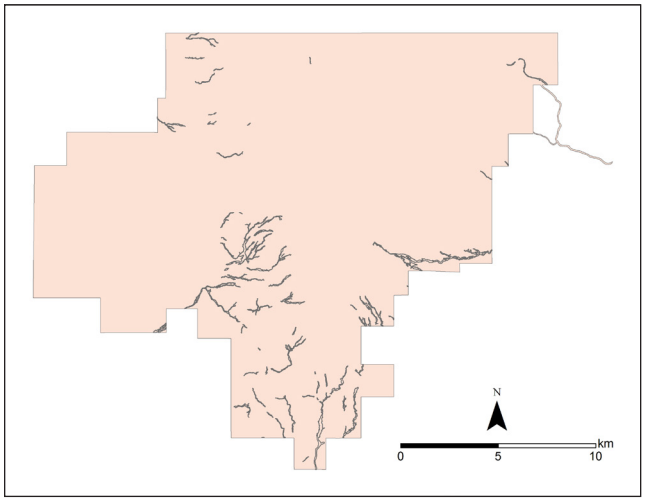


Figure D112. Distribution

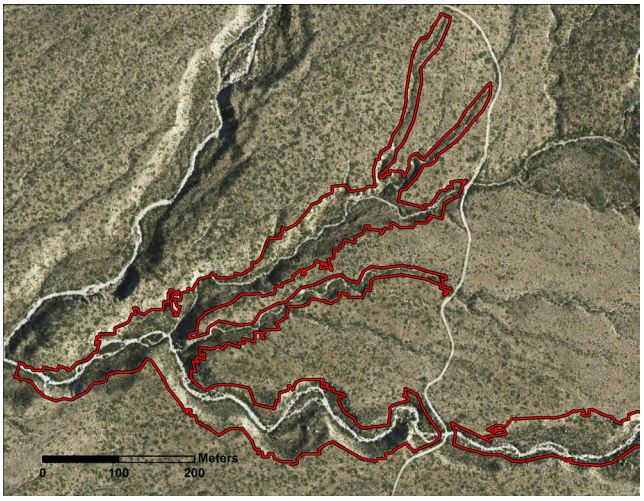


Figure D114. Photo Map Detail

12C Chihuahuan Desert Scrub Dry Wash Riparian Shrubland

Area: 1,288 Ha; 3,182 Acres
Polygons: 289

Primary Component Associations
Larrea tridentata - Flourensia cernua / Sparse Shrubland
Larrea tridentata / *Muhlenbergia porteri* Shrubland

Secondary Component Associations
Flourensia cernua / *Muhlenbergia porteri* Shrubland
Prosopis glandulosa Desert Wash Shrubland
Dry Wash

Summary
These desert wash shrublands are dominated by creosotebush, tarbush, fourwing saltbush, honey mesquite and a diverse mix of other scattered shrubs and subshrubs. Grasses can be abundant and include bush muhly, streambed bristlegrass, and Arizona cottontop, among others. Forbs can also be high in cover on occasion and diverse; hairyseed bahia, plains dozedaisy, fiveneedle pricklyleaf, and conyza are the most common and abundant.

These extensive shrublands are found in desert washes that dissect the lower alluvial fan piedmonts (bajadas) that extend out from the western escarpment of the Guadalupe Mountains and Patterson Hills before coalescing and terminating at the basin floor (Figures D115–D117). The washes lack perennial water but are subject to episodic, often large flooding events during summer rainstorms.



Figure D116. Elev.: 3,669 to 5,828 ft (1,118 to 1,776 m)

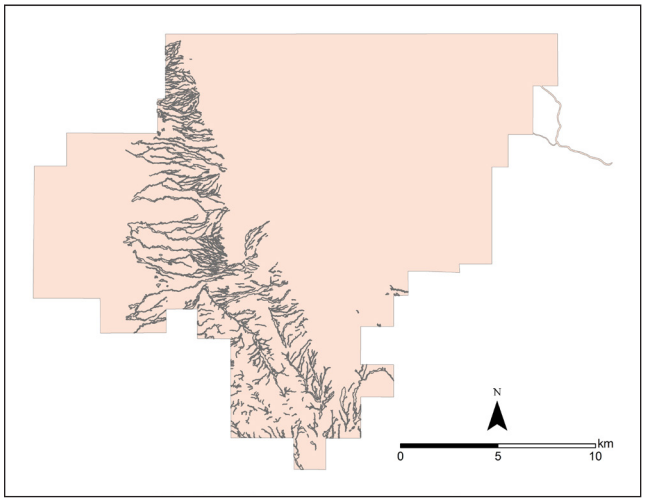


Figure D115. Distribution

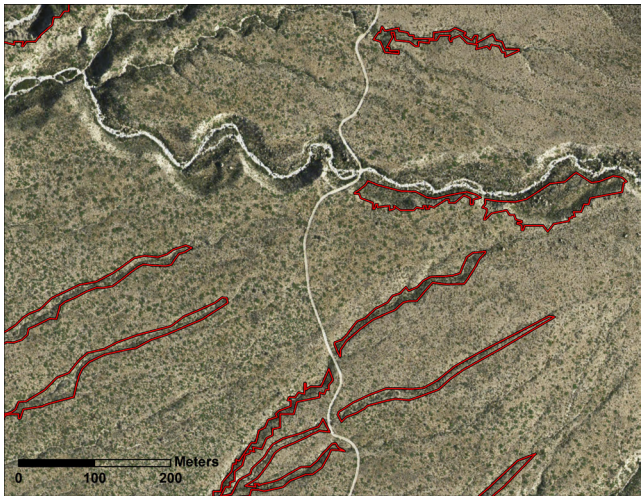


Figure D117. Photo Map Detail

13 Western Interior Riparian Forest & Woodland

13A Mixed Riparian Woodland and Shrubland

Area: 51.79 Ha; 128.0 Acres
Polygons: 12

Primary Component Associations
Acer grandidentatum - Quercus muehlenbergii Forest
Acer grandidentatum - Quercus grisea Forest

Secondary Component Associations
Populus deltoides / Muhlenbergia asperifolia Flooded Forest
Dry Wash

Summary
Lowland riparian woodlands are dominated broad-leaf deciduous trees that include bigtooth maple, chinkapin oak, and plains cottonwood. Other common tree associates include alligator juniper, Texas madrone, little walnut, and Knowlton's hophornbeam. Shrubs can be abundant and include green sotol, cliff fendlerbrush, and black cherry. Grasses and forbs are also diverse and often represented by more mesic species such as plumed brickellbush, bracted bedstraw, Schied's flax, and branched noseburn.

Stands are restricted to river bars and terraces along perennial or intermittent stream channels which likely have a sustained shallow groundwater table during most of the year (Figures D118–D120). They are also subject to episodic flooding as a function of summer rainstorms and occasionally winter snowmelt.

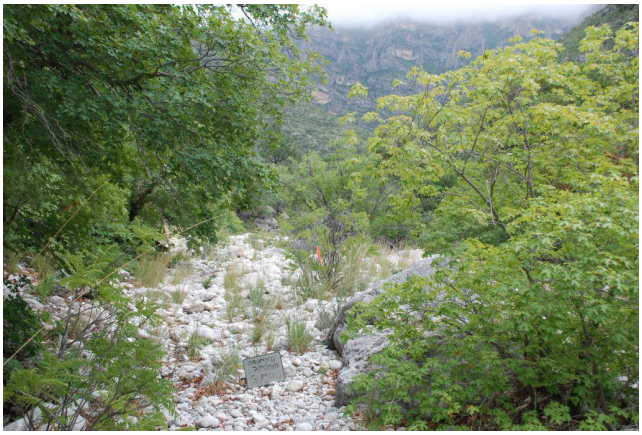


Figure D119. Elev.: 4,201 to 7,281 ft (1,281 to 2,219 m)

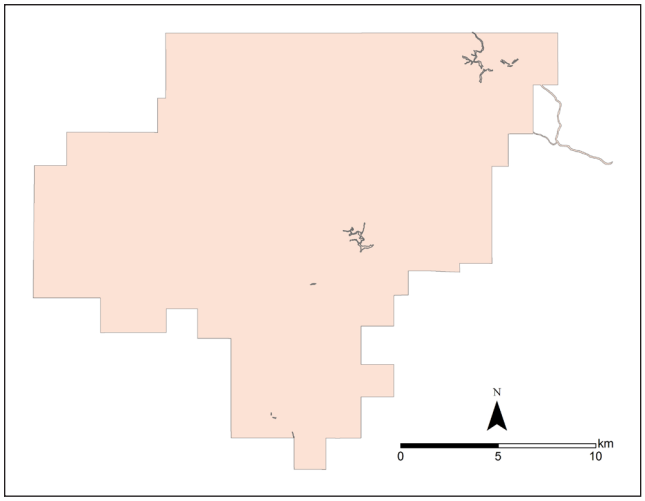


Figure D118. Distribution

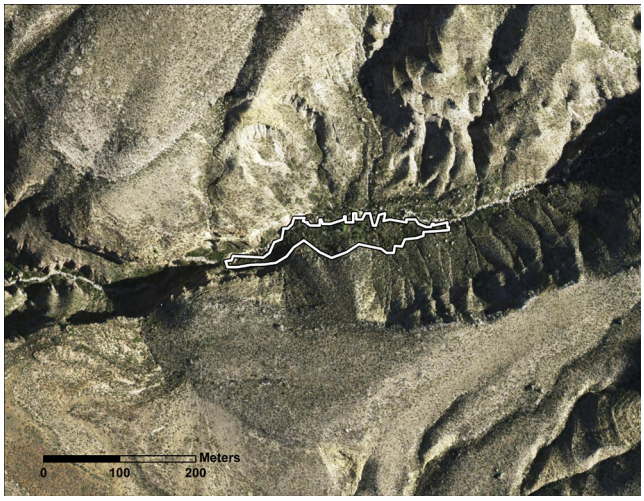


Figure D120. Photo Map Detail

14 Arid West Interior Freshwater Marsh

14A Herbaceous Wetland

Area: 6.578 Ha; 16.26 Acres
Polygons: 4

Primary Component Associations
Schoenoplectus americanus Western Marsh

Summary
Herbaceous wetland that may be dominated by American bulrush, switchgrass, meadow fescue, beaked spikerush, or California sawgrass, among others.

Restricted to spring and pond areas or bordering the channels of intermittent and perennial steams (Figures D121–D123).



Figure D122. Elev.: 5,066 to 5,656 ft (1,544 to 1,724 m)

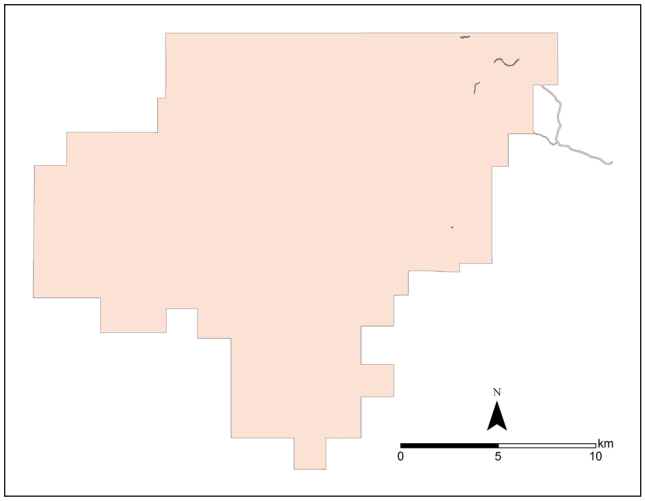


Figure D121. Distribution

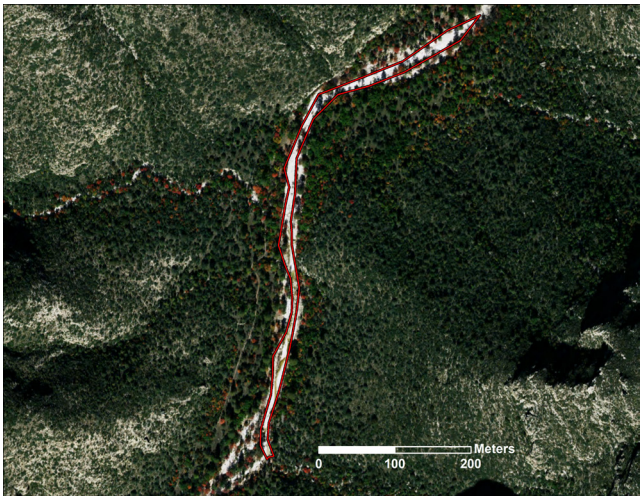


Figure D123. Photo Map Detail

15 North American Warm Desert Ruderal Grassland

15A Ruderal Grassland

Area: 16.92 Ha; 41.80 Acres
Polygons: 19

Primary Component Associations
Setaria leucopila / *Solanum elaeagnifolium* Ruderal Grassland
Bouteloua gracilis Ruderal Grassland

Secondary Component Associations
Disturbed / Tank

Summary
Vegetation dominated by a combination of grasses and weedy forbs. Sand dropseed, streambed bristlegrass and blue grama are the most common and abundant grasses. Forbs are indicative of disturbed ground such as silverleaf nightshade, golden crownbeard, horehound, and buffalo gourd.

Stands typically occur on disturbed ground such as abandoned home sites, corrals, roadsides, stock tanks, etc. (Figures D124–D126).



Figure D125. Elev.: 4,400 to 6,605 ft (1,341 to 2,013 m)

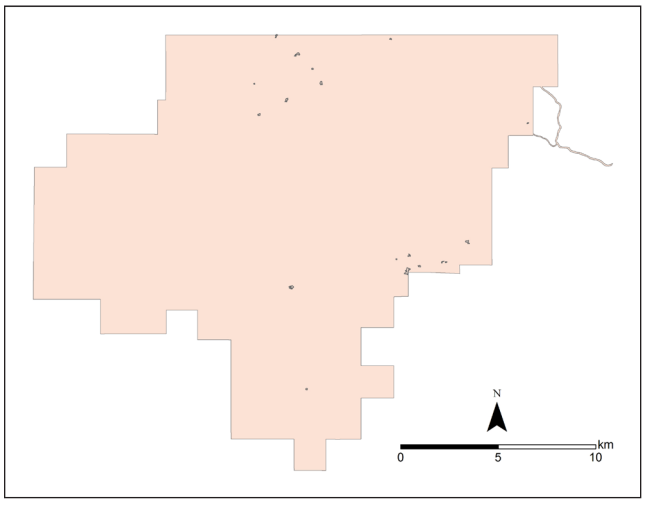


Figure D124. Distribution

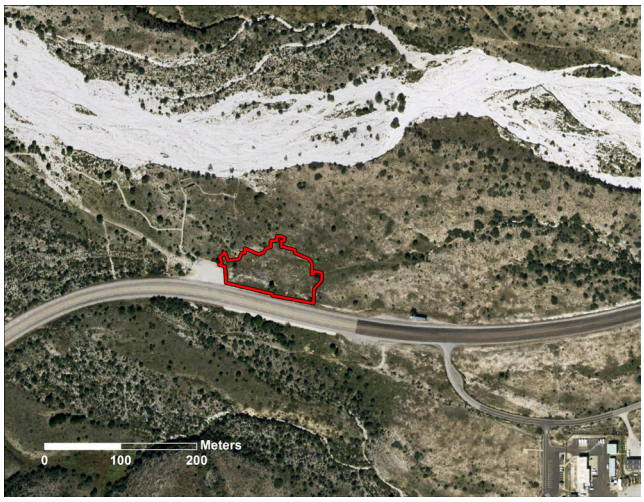


Figure D126. Photo Map Detail

16 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation

16A Sparse Vegetation - Rockland / Scarp / Cliff

Area: 742.3 Ha; 1,834 Acres
Polygons: 151
Elev.: 5,038 to 8,706 ft (1,536 to 2,653 m)

Summary
Bare rock (cliffs) or natural bare ground with little or no vegetation cover (Figures D127–D128) .

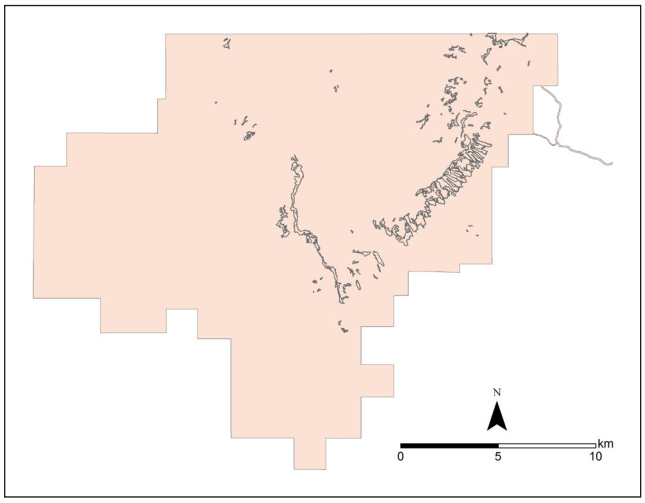


Figure D127. Distribution

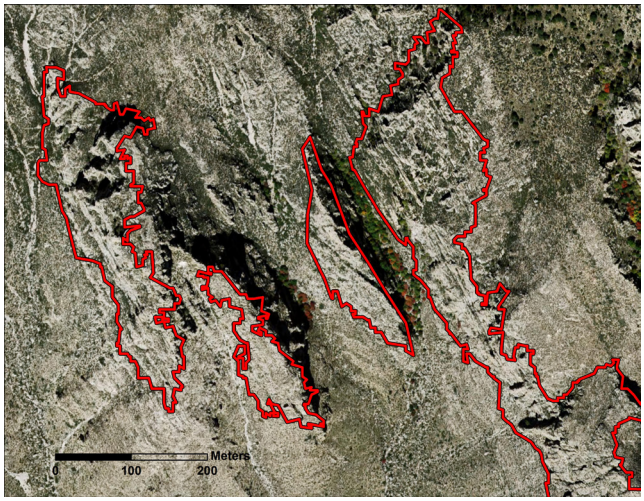


Figure D128. Photo Map Detail

17 Built-up Land - Miscellaneous

17A Road

Area: 98.46 Ha; 243.3 Acres
Polygons:10
Elev.: 3,622 to 6,525 ft (1,104 to 1,989 m)

Summary
Paved highways and major dirt or gravel roads (Figures D129–D130).

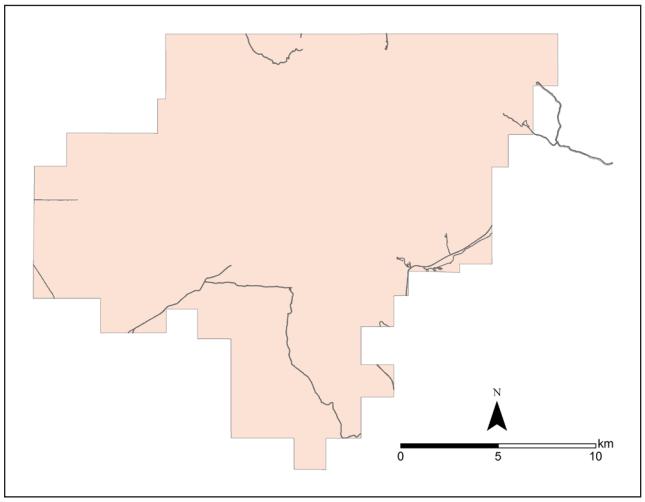


Figure D129. Distribution

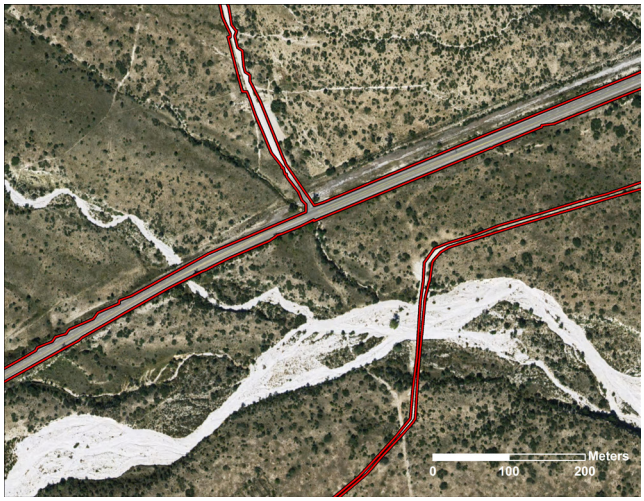


Figure D130. Photo Map Detail

17B Recreation Site

Area: 4.632 Ha; 11.44 Acres
Polygons: 6
Elev.: 5,768 to 6,295 ft (1,758 to 1,919 m)

Summary
NPS recreation sites (Figures D131–D132).

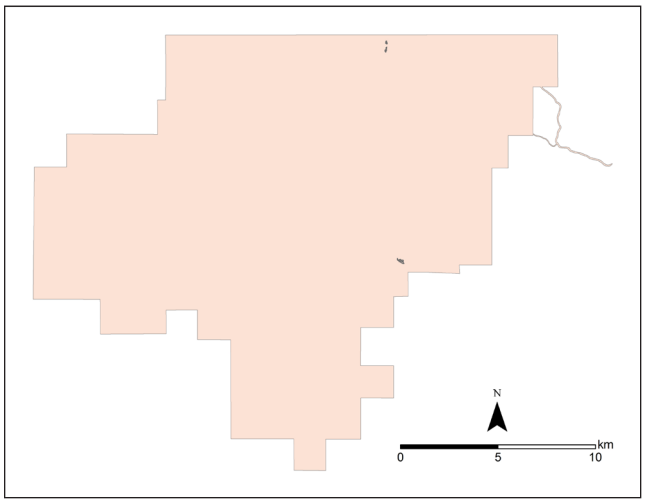


Figure D131. Distribution

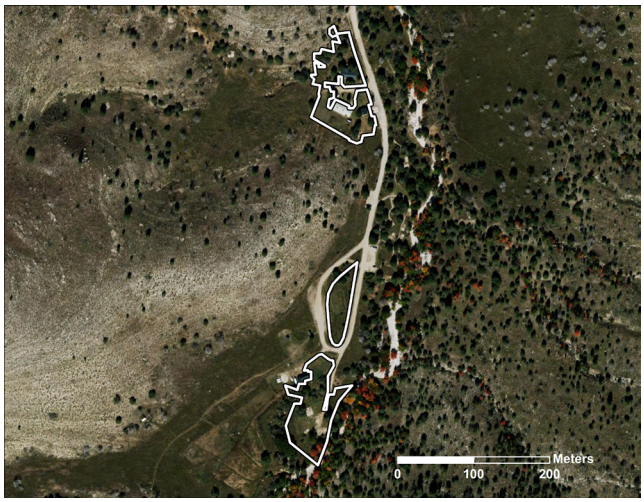


Figure D132. Photo Map Detail

17C Agriculture / Old Field

Area: 1.739 Ha; 4.297 Acres
Polygons: 2
Elev.: 5,495 to 6,336 ft (1,675 to 1,931 m)

Summary
Disturbed areas of old fields (Figures D133–D134).

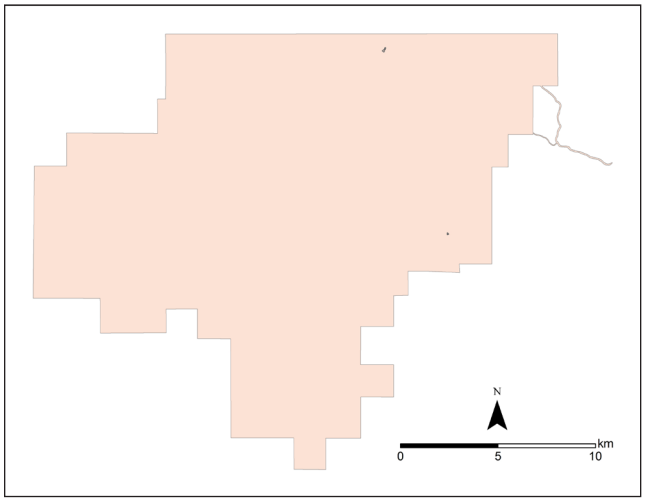


Figure D133. Distribution

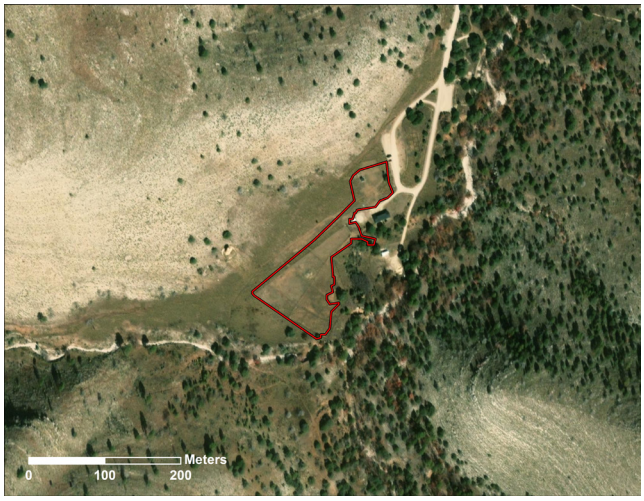


Figure D134. Photo Map Detail

17D Residential / Built-up Vegetation

Area: 16.81 Ha; 41.54 Acres
Polygons: 8
Elev.: 5,229 to 5,733 ft (1,594 to 1,747 m)

Summary
Vegetation in and around NPS residential areas (Figures D135–D136).

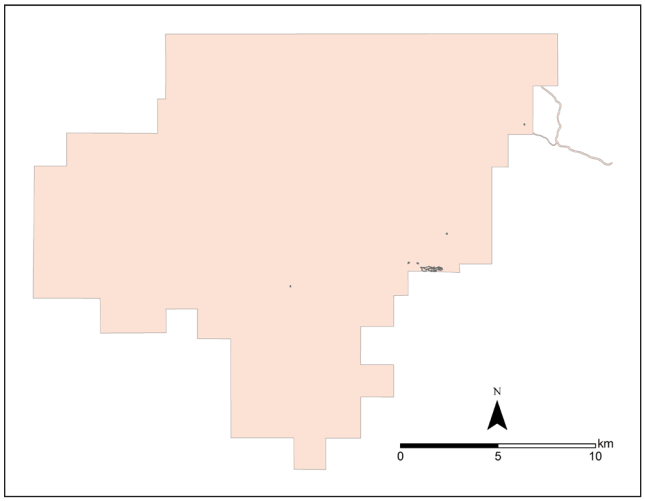


Figure D135. Distribution



Figure D136. Photo Map Detail

17E Sparse Vegetation - Bare Soil / Disturbed Ground

Area: 33.93 Ha; 83.85 Acres
Polygons: 32
Elev.: 3,629 to 5,697 ft (1,106 to 1,737 m)

Summary
Human-disturbed disturbed ground lacking significant vegetation (Figures D137–D138).

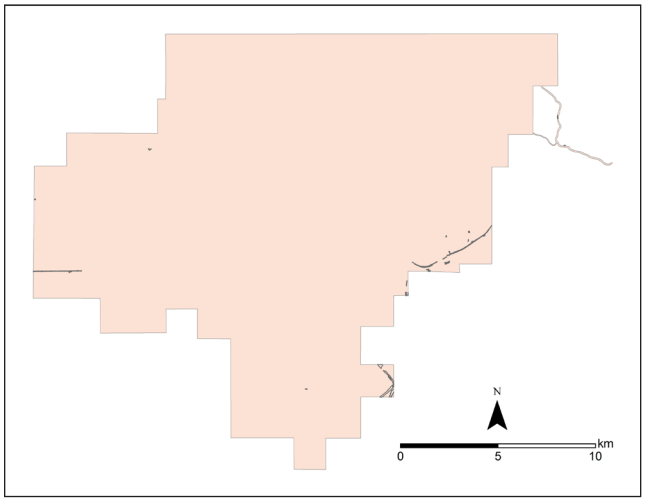


Figure D137. Distribution

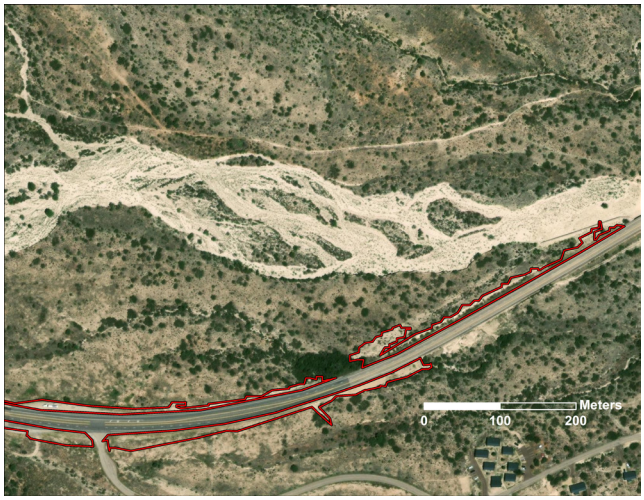


Figure D138. Photo Map Detail

Appendix E. Guadalupe Mountains National Park Vegetation Map Accuracy Assessment Report

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May 2016

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Introduction

The purpose of the project was to initiate Step 10 of the NPS Vegetation Inventory accuracy assessment (AA) effort in Guadalupe Mountains National Park (GUMO) in accordance with the 12-Step Guidance for NPS Vegetation Inventories (NPS 2012). This project entailed conducting accuracy assessments at 345 target points at GUMO (Supplement 1). Four field surveys were conducted between November 2013 and October 2014. The existing "Keys to Guadalupe Mountains National Park Plant Associations" (Supplement 2) was tested in the field to determine if the plant associations fit the key at designated target points. This information will be used to provide an index of reliability for the mapping efforts to date. The AA field data were entered into the PLOTs Database (v3.2) and submitted to NPS.

Guadalupe Mountains National Park is located in Hudspeth and Culberson counties in Trans-Pecos Texas. GUMO comprises 86,367 acres and includes the four highest peaks in Texas (Maliszkiewicz 2010). Elevation ranges from approximately 3,600 to 8,751 ft (Guadalupe Peak). The Guadalupe Mountains preserve exposed remnants of the Permian Capitan Reef. GUMO vegetation consists of representative examples of the Chihuahuan Desert ecosystem with riverine, floodplain, limestone plains, canyons, hills, high desert and mountain landscapes. The Salt Basin, an intermittently wet lake bed with deposits of gypsum and quartz, is located on the west side of the park (Maliszkiewicz 2010). Dune fields and associated low desert plant communities are located within the Salt Basin.

The AA data was collected in accordance with the data fields in the PLOTs Database version 3.2 (PLOTs v3.2, NatureServe). Data was recorded in the field the using a GUMO AA vegetation inventory data form modified to capture the data needed to test the Keys to Plant Association (Supplement 2). Field vegetation data collection followed standard vegetation survey methods detailed in the Gradsect and Field Sampling Plan for Big Bend National Park/Rio Grande Wild and Scenic River (Cogan and Von Loh 2011).

Methods

Planning and Scoping for Field Survey

The NPS Inventory and Monitoring Program provided a list of accessible target points. These target points are the centroids of the AA sample plot locations in the park (Figure E1). Each target point has a unique number and associated Vegetation Class code. (i.e. IRS-0001-2C, IRS-0002-10A). The target point number is identical to the AA plot number. See Supplement 1). Criteria for selection were that the target points be located one kilometer or less from a passable road or trail and not blocked by slopes > 30%. The target points were added to the GUMO base map and used to plan and execute the field work. The target points are located by X-Y coordinates (Universal Transverse Mercator (UTM), using the NAD 83 datum. The UT-Lady Bird Johnson Wildflower Center (LBJWC) field survey team created a set of spatial databases and supporting material including aerial and topographic field maps to access the target points in the field. Supplement 4 contains examples of the maps. The vascular plant species check list for Guadalupe Mountains National Park (NPS 2013) was referenced as the current species list.

Field Sampling Methods

Field sampling (Figure E2) took place on the following dates: November 11–13, 2013; June 10–19, 2014; September 3–8, 2014 and October 15–20, 2014.

To conduct the surveys, GUMO was divided into two sections based on elevation. One team of four crew members surveyed the higher elevations in the mountain range and another team of four crew members surveyed the mid and lower elevations on the eastern and western flanks of the mountains. One project constraint was that we were not successful in obtaining landowner permission from the Pietila or Ligon properties on the east side of GUMO to access target points west of those property boundaries. As a result, these portions of the park were not surveyed.

Access to target points at GUMO was limited by a general lack of trails and roads and rugged terrain. The IRS 1,885 target points and associated Vegetation Classification codes (i.e. IRS-0001-2C) were loaded onto Garmin Montana 650t GPS units. For AA plot selection, accessible areas in the park with the widest array of potential

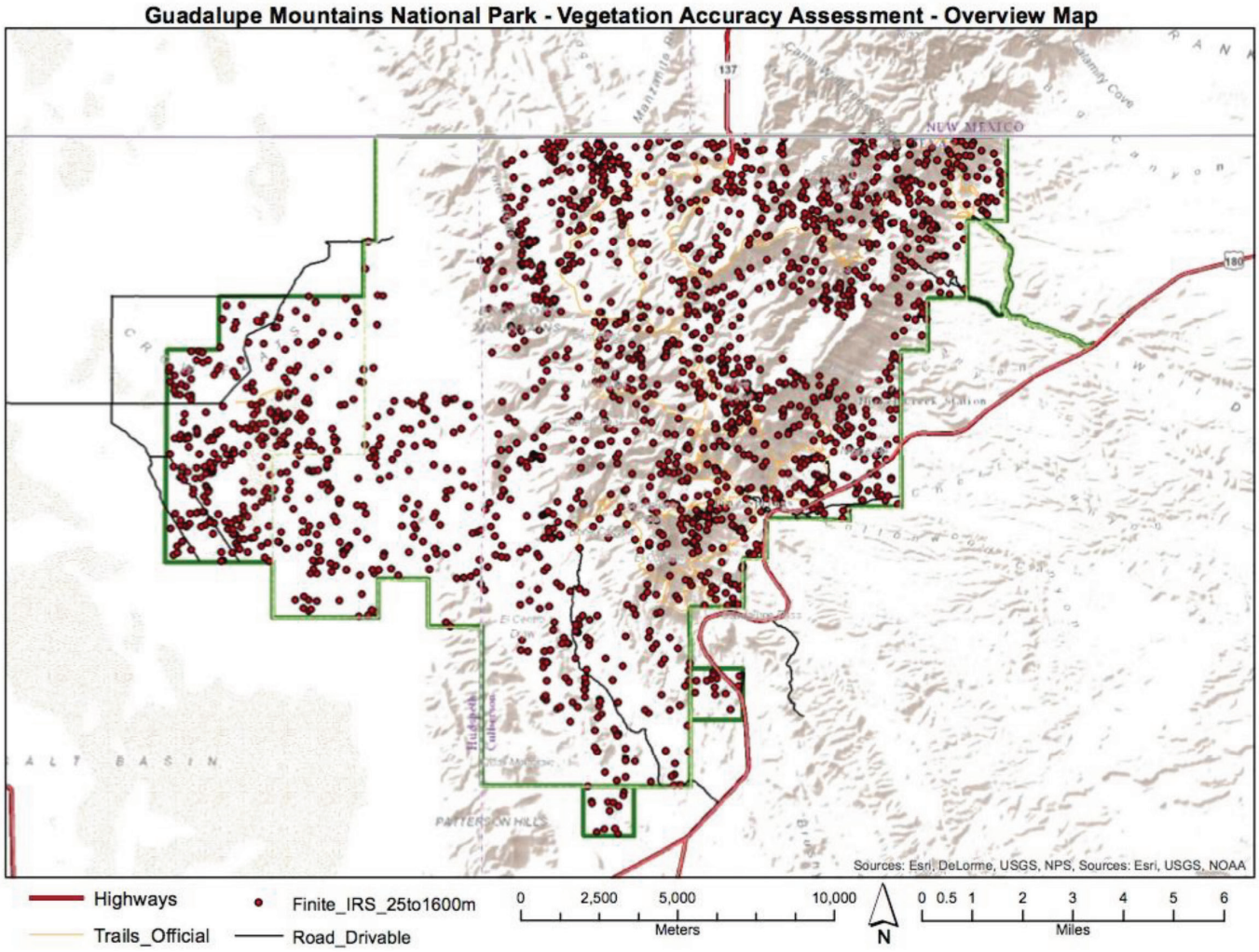


Figure E1. Locations of the set of 1,885 target points for Guadalupe Mountains National Park vegetation map accuracy assessment project.

target points in a given area were chosen to allow for sampling the greatest number of vegetatively diverse plots (per the Vegetation Classification codes [i.e. IRS-0001-2C] listed with the target points). The goal of the field sampling effort was to sample a minimum of 300 target points from the total 1,885 potential points.

During surveys, selection of target points for AA plots was governed by accessibility from trails or roads (Figure E2). For any given area, the target points/plots most accessible by foot from the trail or road were chosen. The GPS units were used to navigate to the target points, record locational data on the data sheets and photograph the plots. The vegetation classification codes and IRS site ID target point numbers were used to keep track of the number of sites sampled within each vegetation class on the target point list.

The field data were collected using forms provided by the primary investigator, Este Muldavin. These forms were modified by UT-LBJWC from the standard PLOTs Database collection form to fit the requirements for collecting the data necessary to test the key (Supplement 2). An instruction form for collecting the modified AA data was created by UT-LBJWFC (Supplement 2). Vegetation was sampled at a target point using the "Keys to Guadalupe Mountains National Park Plant Associations, Draft" (Muldavin 2013; Supplement 2). The key is dichotomous and vegetation associations are grouped by major vegetation classes (e.g., forests and woodlands, shrubland, etc.). Within those major classes, vegetation is then keyed to plant association. Garmin Montana 650t GPS units were used to record and collect field data. The standard plot size was 0.5 ha and the standard plot shape was a circle. A few rectangular plots also used where warranted by the terrain. Plot numbers are the same as the IRS target point numbers (Supplement 1).

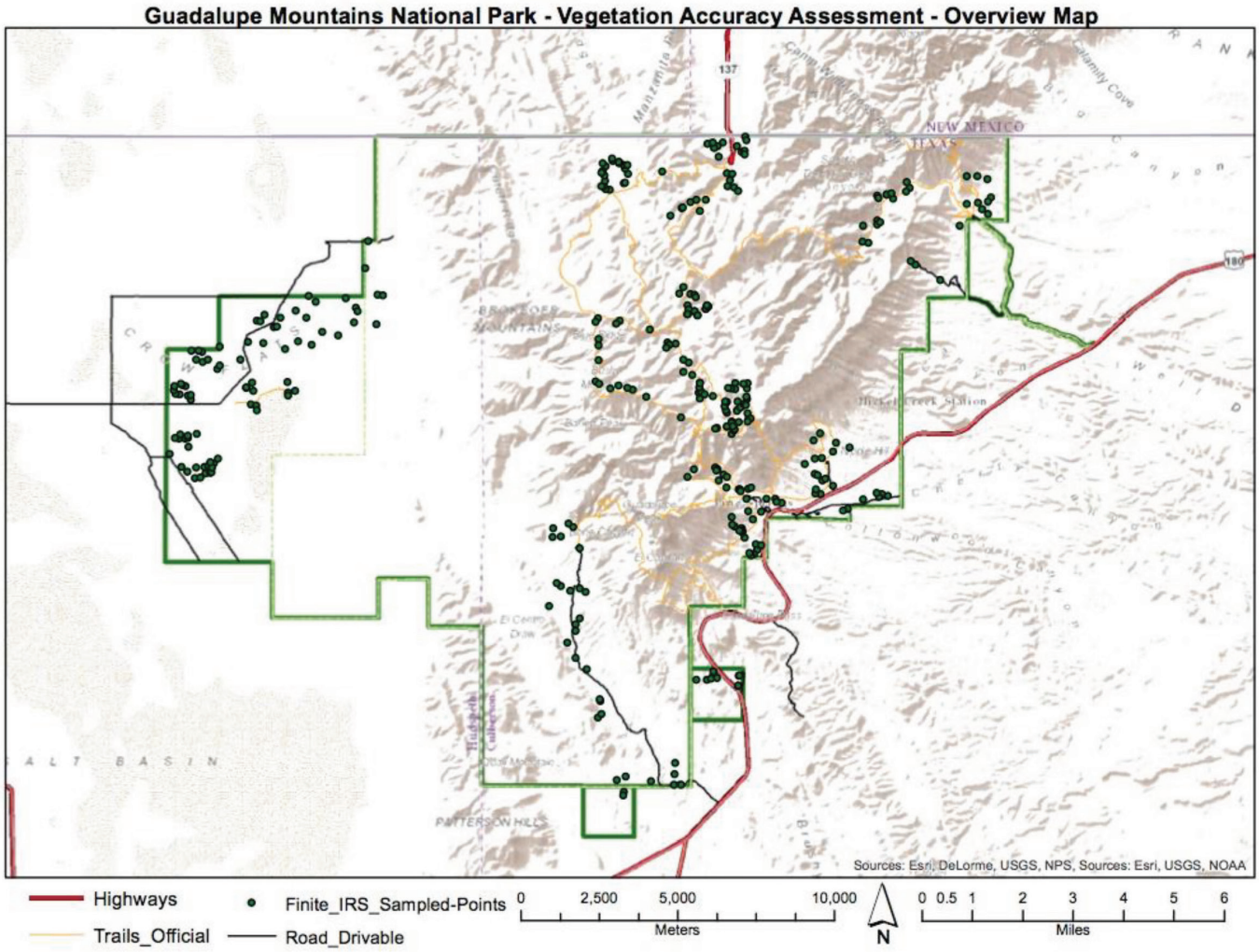


Figure E2. Locations of the 345 plots sampled for the Guadalupe Mountains vegetation map accuracy assessment project.

The procedure to test the key included the following steps. For each AA plot, a 0.5 ha plot was laid out by pacing a 40-m radius from the target point (also the center of the plot), which formed the virtual boundary of the circle of the plot. In accordance with the AA protocol, dominant plant species were identified within a cover class using stratum (tree, shrub, subshrub and graminoid), percent cover of each stratum, and cover scale of the three dominant taxa per stratum. The plant association was then identified using the key. The field crew determined the extent to which the key fit the association. The primary association name was recorded and if warranted, a secondary association name was also recorded per the key. At each target point (the center of the AA plot), 4 photographs were taken to provide an image record of the plot vegetation. The first photograph (photo 1) was taken upslope from plot center, the second taken 90 degrees from photo 1, the third taken 180 degrees from photo 1, and the fourth taken 270 degrees photo 1. The bearing of each photo was recorded on the datasheet.

Results

Plant Communities

A total of 345 target points (plots) were sampled (Figure E2). Following the key, A plant association name (e.g. *Juniperus deppeana*/*Muhlenbergia pauciflora* Woodland) from the key was assigned to each plot. If the plant association did not fit any choice in the key, this was noted. Fifty two vegetation associations were assigned to the 345 plots. Supplement 3 lists the 345 sampled target points by plant association referenced in "Keys to Guadalupe Mountains National Park Plant Associations."

Plant Species

The vascular plant species checklist for Guadalupe Mountains National Park (NPS 2013) was referenced as the authority for known plant species. The USDA Plants Database (USDA NRCS 2015) was referenced as the scientific nomenclatural authority. The list was incorporated into the xPLANTS_tSpecies Table in the PLOTs Database. The complete list of plant taxa identified during field survey is recorded in the PLOTs Database tPlotEventSpecies Table (CHDN).

PLOTs Database

Upon completion of field surveys, an electronic scan of each original field datasheet (paper) was made for backup. The original datasheets were then checked for accuracy and corrections were made on the datasheets before entering to the PLOTs Database. After final corrections were made to the datasheets, a second set of electronic copies was made for backup. Data were transferred from the field datasheets to the PLOTs Database (version 3.2) following the steps in the PLOTs Database User's Manual (Fink et al. 2011). The data in the PLOTs Database was QA/QC by UT-LBJWC and Chihuahuan Desert Inventory & Monitoring Network (CHDN) staff. CHDN and UT-LBJWC were also responsible for certifying the data. It should be noted that the Vegetation Associations from the Keys to Guadalupe Mountains National Park Plant Associations are not recorded in the PLOTs Database because, to date, no designated field exists to enter the names of these vegetation classifications. Instead, the names of the plant associations are listed in Supplement 3, this report, and in an excel database file provided the CHDN.

Project Deliverables

Project deliverables for the completed phases of the project were conveyed to NPS in July 2015 (Table E1).

In accordance with the Work Plan, Project Deliverables include the following:

- An excel spreadsheet titled "PLOTs Database QA_QC spreadsheet excel file" was created to index all deliverables and recipients. This spreadsheet serves as the index for all information entered into the different sections of the PLOTS database. Although the project entailed collection of AA data and entering it into the AA section of the database, reporting in the data base also entailed using the Vegetation Classification Tab. As noted earlier, The AA Primary and Secondary Plant Association names are not entered into the PLOTS database because a field for this part of the data entry is lacking. As a result, the AA Primary and Secondary Plant Association names in Keys to Guadalupe Mountains National Park Plant Associations (Muldavin 2013) are only recorded the PLOTs Database QA_QC spreadsheet excel file. Supplement 3, this report, also contains the list of the Primary and Secondary Plant Association names from the Keys to Guadalupe Mountains National Park Plant Associations
- GIS materials including data layers, maps, waypoints and digital record of all data recorded in the GPS database during the survey
- Hard copies of field forms and electronic scans, digital images of each plot, data forms and instructions
- PLOTs Database

Table E1. List of GUMO AA Survey Product Deliverables

Deliverable Name	Description	Type of File	Folder name	Subfolder name	NPS Recipient(s)	Other Recipient(s)
Datasheet	Copy of field datasheet form and instructions	doc	GUMO Datafiles	–	Tammy Cook	Este Muldavin
GUMO Datasheets_Scans	Scans of corrected original field datasheets	pdf	GUMO Datafiles	–	Tammy Cook	Este Muldavin
Plants_lu_table additions	List of plant taxa added into Plants_lu table in PLOTS_v3.2_BE	excel	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
PLOTS Database_v32	GUMO PLOTS Database_v32	Access	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
PLOTS Database_v32_BE	GUMO PLOTS Database_v32_BE	Access	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
GUMO_Images_ PLOTS_List	List of GUMO PLOTS images	excel	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
PLOTS IMAGES	IMG files of PLOTS images	IMG	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
Plots Database List Veg Key Plots Classification	List of veg key plots classifications	excel	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
Plots Database QA_ QC spreadsheet	Plots Database QA_QC excel spreadsheet	excel	GUMO Datafiles	PLOTS DATABASE	Tammy Cook	Este Muldavin
Vegetation Key (Appendix B)	Original and revised vegetation keys	doc	GUMO Datafiles	Vegetation Key	Tammy Cook	Este Muldavin
Field Data	GIS layer of recorded GPS field data	gis layer	GUMO GIS	–	Tammy Cook	Este Muldavin
Figures_Veg_Survey	Pdf of figures showing all target points and points that were sampled	pdf_png	GUMO GIS	–	Tammy Cook	Este Muldavin
GIS Plots Visited	GIS layer of plots visited	gis layer	GUMO GIS	–	Tammy Cook	Este Muldavin
GUMO Field Maps	pdf of orthographic and topographic field maps used in survey	Pdf digital	GUMO GIS	–	Tammy Cook	Este Muldavin
GUMO_AA_ Reporting	ArcMap document of target points visited	ArcMap doc	GUMO GIS	–	Tammy Cook	Este Muldavin
High Resolution Field Maps	GUMO field maps and GUMO AA overview field maps used in survey	pdf	GUMO GIS	–	Tammy Cook	Este Muldavin
GUMO Datasheets_ Hardcopy originals	Hard copies of GUMO original corrected field datasheets	paper	–	–	Tammy Cook	–
Final Report	GUMO final report	pdf	GUMO Final Report	–	Janet Coles Tammy Cook Marcia Wilson	Este Muldavin

Summary

NPS Vegetation Inventory Step 10 field plot data collection vegetation surveys were conducted at GUMO in 2013 and 2014. Three hundred forty-five AA plots were sampled. Plot data collected in the field were transferred to the PLOTs Database for ongoing development of the NVC vegetation maps for GUMO.

Acknowledgments

We thank the many NPS staff who assisted this project. Dennis Vasquez, GUMO Superintendent, facilitated the participation of NPS staff on the project. GUMO staff ensured our safety in rough terrain throughout the project and we are grateful for all of their professional support in the field. Janet Coles, Chief of Resource Management, and Dr. Jonena Hearst, Geologist, (GUMO) provided important information about field conditions, vegetation and access to target points throughout GUMO. Geoff Clark, GIS Specialist, provided site data. Ranger Ryan Romanchuk contributed invaluable planning and logistical information on field conditions throughout the

project and wrangled the mules to transport field supplies up to the high country for survey work. Dr. Hildy Reiser, CHDN Science Advisor, and staff of the CHDN provided unfailing guidance, reports, data files and maps of existing information on GUMO, which allowed us to successfully scope, plan, and execute the field survey phase of the project. Dr. Tom Philippi, Inventory and Monitoring Program, NPS, provided Geospatial data layers and Finite_IRS_25 to 1600 m target points. Dr. Esteban Muldavin, Director, Natural Heritage New Mexico, provided the draft of "Keys to Guadalupe Mountains National Park Plant Associations" and instructions for data collection. Janet Coles provided final review and edits to this report.

UT-Lady Bird Johnson Wildflower Center field staff participating in the survey included Liz Brewer, Justin Bush, Karen Clary, Dick Davis, Andrew McNeil-Marshall, Minnette Marr, Damon Waitt and Sean Watson. Botanical consultants Andrew Caven and Patty Manning assisted with the field work at GUMO. Justin Bush oversaw the GIS and mapping support. We thank Richard Jinkins, Marcia Jinkins and Tara LeBlanc for their assistance with PLOTs Database entry. This project was funded through Gulf Coast Cooperative Ecosystem Studies Unit (GC-CESU) Task Agreement P13AC501159, between the Department of the Interior, National Park Service, Chihuahuan Desert I & M Network and the University of Texas-Austin.

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Supplement 1. List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled by Location

Table E2. List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-0002	3529752.5691	499109.7128
IRS-0012	3530031.7722	499167.6971
IRS-0016	3532356.6719	501770.7763
IRS-0018	3529732.7329	499062.2449
IRS-0021	3529717.6731	498914.4551
IRS-0033	3529918.8527	498881.2885
IRS-0040	3529967.3871	499016.3141
IRS-0045	3530080.7736	499054.2399
IRS-0047	3529574.2652	498739.4174
IRS-0048	3529555.1127	498565.4323
IRS-0052	3534767.4584	500799.4742
IRS-0054	3532249.5379	497955.0451
IRS-0057	3533628.5055	498680.9370
IRS-0058	3530827.8685	498069.2541
IRS-0061	3532221.1865	498449.8159
IRS-0062	3533594.2402	498806.2642
IRS-0064	3530828.2773	498262.6914
IRS-0070	3532498.9386	497915.0147
IRS-0071	3533352.0772	498605.8519
IRS-0076	3532491.9986	498280.1778
IRS-0082	3533621.0003	498452.6744
IRS-0085	3532348.5477	500440.5509
IRS-0087	3530914.1638	498354.3184
IRS-0095	3530950.4533	498097.7346
IRS-0097	3532366.1545	497897.0270
IRS-0105	3532452.2878	500210.1790
IRS-0105	3532454.1721	500211.0298
IRS-0112	3530337.2379	497764.1478
IRS-0114	3532566.2913	498114.9553
IRS-0118	3533266.1492	498811.9917
IRS-0119	3530185.8301	499313.4112
IRS-0126	3533150.9356	499367.8660
IRS-0131	3533913.7297	500266.6619
IRS-0134	3533350.3689	498995.9390
IRS-0144	3533763.5562	499359.6809
IRS-0149	3533045.5312	499281.7485

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-0150	3531908.5052	500357.3798
IRS-0157	3531876.0363	500531.4187
IRS-0167	3532205.5593	501547.8974
IRS-0181	3529918.4043	498150.4924
IRS-0190	3529910.0730	499119.3708
IRS-0191	3529765.7462	498327.3752
IRS-0194	3531734.9364	500544.7556
IRS-0195	3532299.6636	501549.4902
IRS-0196	3529900.1532	498613.9861
IRS-0202	3530845.5204	497925.2670
IRS-0208	3534565.4952	500659.8993
IRS-0214	3530560.5780	498375.4400
IRS-0215	3532615.8952	500404.2408
IRS-0216	3534584.9972	500555.6542
IRS-0219	3530971.9833	498621.6946
IRS-0221	3532071.1091	498439.8672
IRS-0231	3532242.0872	498080.5808
IRS-0232	3533342.6716	500029.5239
IRS-0233	3530835.3565	498350.8076
IRS-0250	3532194.4885	498355.7530
IRS-0263	3525093.7769	510857.9816
IRS-0270	3523294.6049	515140.0183
IRS-0280	3525481.1806	509887.3254
IRS-0314	3527689.7871	510001.7121
IRS-0317	3522030.2591	511560.9673
IRS-0323	3524688.1903	510731.3615
IRS-0336	3522506.3650	511505.7408
IRS-0339	3524905.9906	510730.6609
IRS-0341	3521931.8067	511438.0638
IRS-0346	3528111.8204	510508.0978
IRS-0348	3522459.1638	511520.5546
IRS-0349	3527964.0190	510014.1172
IRS-0369	3529603.1745	515557.9259
IRS-0374	3538514.3490	523998.4797
IRS-0382	3535884.0377	522382.1148
IRS-0387	3538380.1131	523901.8630
IRS-0412	3534377.7677	501101.7518
IRS-0421	3534912.8963	501785.8258

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-0430	3534393.2959	501194.2766
IRS-0448	3534679.8335	501295.0837
IRS-0454	3535418.6830	504404.9472
IRS-0465	3519888.2825	513130.2267
IRS-0469	3535310.7786	503385.9707
IRS-0480	3519771.6610	513876.2832
IRS-0481	3535004.8605	503719.1095
IRS-0483	3536263.2490	504019.0483
IRS-0484	3519771.6255	514094.7271
IRS-0488	3523255.1409	515941.6570
IRS-0488	3523252.6445	515960.0739
IRS-0493	3527334.1885	510852.5854
IRS-0498	3537119.5363	504104.1272
IRS-0500	3526041.6840	510858.6818
IRS-0535	3534115.4967	503143.0878
IRS-0543	3525935.7074	511054.0265
IRS-0546	3520481.0743	513905.8003
IRS-0552	3535193.9033	502437.1914
IRS-0555	3534468.0918	504373.4118
IRS-0559	3534686.4015	502127.7025
IRS-0561	3534529.1052	503654.2596
IRS-0567	3534222.7598	502639.5854
IRS-0567	3533865.0946	500754.9331
IRS-0581	3533931.8533	501870.5883
IRS-0583	3533684.8317	501458.4417
IRS-0589	3532637.5047	501530.1556
IRS-0591	3535370.5318	502203.3510
IRS-0592	3533824.4229	502292.4347
IRS-0606	3523121.3371	514586.5834
IRS-0610	3523165.6799	515052.4054
IRS-0617	3522938.0054	515927.6726
IRS-0617-a	3522936.0390	515930.4773
IRS-0617-b	3522936.0390	515930.4773
IRS-0620	3523190.9150	515253.1414
IRS-0630	3528324.2268	515717.9464
IRS-0638	3527259.6630	516533.9849
IRS-0643	3523128.2547	514927.0001
IRS-0654	3520038.4832	512334.9323

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-0662	3519554.1485	512270.4897
IRS-0663	3528818.6137	517139.8342
IRS-0665	3519435.9693	512250.0917
IRS-0666	3528769.7087	517323.3695
IRS-0668	3528011.7719	510654.9733
IRS-0679	3520110.1921	513896.2695
IRS-0686	3529093.0556	520352.5517
IRS-0698	3528902.4552	516832.7444
IRS-0699	3523824.8473	510722.3296
IRS-0723	3526221.3836	510126.3900
IRS-0749	3525968.3284	510559.8577
IRS-0755	3528587.1412	519420.2883
IRS-0761	3529212.1209	515986.3064
IRS-0762	3529222.1813	516251.7191
IRS-0764	3528523.0278	519277.8040
IRS-0767	3529141.4174	515994.7380
IRS-0769	3529210.7208	515941.3929
IRS-0775	3528912.3333	517108.6611
IRS-0782	3528878.9135	519902.5737
IRS-0784	3539001.9481	521298.7072
IRS-0851	3533334.1311	511467.1440
IRS-0857	3534558.7011	511360.0157
IRS-0858	3532591.2649	516218.5853
IRS-0866	3533884.7311	513673.9529
IRS-0867	3532425.0658	515690.0485
IRS-0869	3532397.4638	515832.5476
IRS-0872	3531166.7823	515242.6203
IRS-0875	3531215.0071	515761.2005
IRS-0877	3531889.4544	516172.9965
IRS-0878	3531145.0774	515181.3897
IRS-0881	3531343.5422	515949.6098
IRS-0882	3531864.7902	515490.3980
IRS-0883	3531988.5946	515559.7877
IRS-0886	3531931.4758	516110.5374
IRS-0888	3532001.0382	515506.0736
IRS-0892	3531641.0158	516216.1195
IRS-0893	3532420.5556	511839.3851
IRS-0894	3533803.2013	511456.9779

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-0895	3532449.2370	512379.3985
IRS-0896	3534970.9075	514891.7270
IRS-0896	3534970.9075	514891.7270
IRS-0910	3532160.2608	512995.6245
IRS-0920	3535031.8678	514965.8253
IRS-0920	3535031.8678	514965.8253
IRS-0923	3533850.6100	513934.0136
IRS-0925	3532517.7402	512103.8588
IRS-0927	3535455.0723	514034.0801
IRS-0930	3533347.0466	514169.3952
IRS-0938	3532170.4852	515115.3992
IRS-0944	3535411.1005	514533.6790
IRS-0945	3532959.2147	514171.6334
IRS-0947	3532862.1756	514451.1857
IRS-0955	3532283.4408	514663.4684
IRS-0969	3535074.5891	514922.1958
IRS-0969	3535074.5891	514922.1958
IRS-0973	3531200.5329	515573.8423
IRS-0980	3531225.5752	515568.6990
IRS-0986	3535427.3137	514398.3290
IRS-0989	3538091.2987	514692.7116
IRS-0996	3531129.9417	515800.7553
IRS-1006	3534757.9290	514625.8072
IRS-1006	3534757.9290	514625.8072
IRS-1010	3531847.7413	516008.4766
IRS-1018	3531739.6092	515897.7546
IRS-1023	3532591.5540	515836.6904
IRS-1029	3538885.4889	515592.5317
IRS-1031	3532010.0627	515897.8075
IRS-1034	3531826.8737	515989.6966
IRS-1042	3531700.0061	515876.7344
IRS-1043	3531368.2517	516226.7615
IRS-1046	3534891.7095	503769.0501
IRS-1049	3534499.0519	512024.8686
IRS-1056	3533826.0524	513724.3142
IRS-1060	3535345.3188	514574.7866
IRS-1062	3533713.9827	513634.8616
IRS-1066	3531365.7861	515711.6189

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-1076	3534588.7426	512135.4340
IRS-1079	3534309.6087	513096.7657
IRS-1091	3531331.3206	515715.6424
IRS-1093	3532654.1135	511363.3582
IRS-1104	3532468.1308	514682.9606
IRS-1111	3532568.2360	511484.7332
IRS-1119	3532239.9279	514850.5140
IRS-1128	3531651.7572	515566.4442
IRS-1137	3531726.9562	515525.3012
IRS-1142	3535659.0012	514179.9917
IRS-1162	3538650.6769	520808.9444
IRS-1164	3538439.5206	514583.7546
IRS-1165	3537782.8728	520361.1720
IRS-1173	3538622.1201	520666.0574
IRS-1173-a	3538621.5773	520670.7897
IRS-1173-b	3538621.5773	520670.7897
IRS-1180	3538444.9335	514878.6008
IRS-1181	3538730.3886	515931.4491
IRS-1193	3529604.4522	514304.2083
IRS-1208	3536377.6758	521582.8452
IRS-1219	3519933.7359	512051.0290
IRS-1220	3536488.5579	521443.5178
IRS-1223	3537621.4851	519910.6244
IRS-1242	3538570.6550	520372.1677
IRS-1246	3535073.3709	514301.9591
IRS-1247	3532327.7790	514741.7709
IRS-1248	3531085.6950	515787.1149
IRS-1266	3532608.2565	514698.2623
IRS-1266	3532603.0429	514695.4340
IRS-1273	3534799.0464	514308.6746
IRS-1273	3534799.0464	514308.6746
IRS-1275	3532392.3746	512560.8702
IRS-1279	3534946.2819	514335.4030
IRS-1285	3532104.3699	514697.6620
IRS-1286	3534883.8249	514533.5774
IRS-1286	3534883.8249	514533.5774
IRS-1292	3530981.9479	515715.3274
IRS-1297	3538984.0845	512304.8540

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-1307	3527708.3255	510254.5824
IRS-1311	3538967.0954	512279.7457
IRS-1313	3538781.8564	511694.7208
IRS-1325	3538878.5547	511635.9443
IRS-1352	3540241.2419	514948.7174
IRS-1359	3533259.1709	514344.2881
IRS-1369	3539063.6150	515666.2287
IRS-1373	3540272.0715	515109.7220
IRS-1382	3534004.5038	511469.5121
IRS-1392	3538849.2068	515785.3069
IRS-1393	3540264.4670	515435.4224
IRS-1395	3529840.5956	515262.4635
IRS-1398	3540350.7457	516179.3270
IRS-1399	3529267.3108	515548.0341
IRS-1400	3528914.4971	516188.4718
IRS-1402	3528510.9178	516238.2461
IRS-1405	3529494.7054	515292.7639
IRS-1407	3540005.3956	516132.2663
IRS-1410	3529900.2191	515181.7210
IRS-1415	3529267.5463	516340.9109
IRS-1425	3537738.5246	520466.6067
IRS-1427	3537655.8665	520370.9676
IRS-1428	3537117.5762	519901.4012
IRS-1429	3540457.7831	516156.0158
IRS-1430	3539270.3198	515727.4096
IRS-1431	3539970.4340	516032.5716
IRS-1432	3539903.2030	516135.1671
IRS-1437	3529839.1696	514509.4403
IRS-1441	3529799.7652	515235.0091
IRS-1442	3538486.7452	520865.7738
IRS-1443	3539298.2343	515571.0248
IRS-1444	3537079.3706	520089.4106
IRS-1454	3530534.0557	519470.6818
IRS-1457	3530414.4970	518959.5899
IRS-1469	3529684.2719	515459.2764
IRS-1489	3538312.8290	523227.8389
IRS-1495	3538196.7166	514147.5252
IRS-1507	3532424.2156	516211.6656

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-1510	3532576.9795	516086.3626
IRS-1511	3532157.8327	516192.4245
IRS-1518	3532437.2445	515608.4507
IRS-1524	3531468.2704	516321.5200
IRS-1538	3532093.2434	516212.2840
IRS-1539	3538182.7104	514118.5403
IRS-1540	3531487.1208	516256.4474
IRS-1565	3529318.3593	518946.1967
IRS-1569	3538135.3869	523718.2037
IRS-1570	3529004.8482	520695.9860
IRS-1586	3529079.2669	518393.0864
IRS-1589	3537995.4676	523893.4091
IRS-1591	3528970.1697	520427.0269
IRS-1594	3530017.3634	518044.8695
IRS-1641	3537932.6057	513761.0942
IRS-1671	3531493.7934	514101.8119
IRS-1739	3539205.5409	523219.3860
IRS-1782	3538495.9072	520407.8389
IRS-1787	3538717.1572	521280.9807
IRS-1790	3538822.9364	521403.8564
IRS-1806	3539318.6123	511549.5736
IRS-1813	3539614.8244	511585.6071
IRS-1818	3539765.5928	511894.5152
IRS-1835	3539360.5570	511590.4298
IRS-1841	3539691.4638	511915.6666
IRS-1846	3539656.0156	512122.2982
IRS-1851	3539211.6575	511654.4583
IRS-1852	3539605.9085	512117.0677
IRS-1853	3539556.4445	512279.1318
IRS-1857	3540163.6257	515885.9523
IRS-1865	3538765.1490	511816.9855
IRS-1868	3539646.5730	512104.6449
IRS-1869	3538879.4565	511551.4871
IRS-1890	3539510.8668	511694.0754
IRS-1891	3539044.5326	511676.8491
IRS-1895	3528491.0708	516648.9786
IRS-1906	3527423.6922	516661.4929
IRS-1908	3529480.7018	518620.8165

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-1910	3528244.8251	516400.5687
IRS-1915	3529662.2949	518456.2437
IRS-1919	3528014.4688	515817.7202
IRS-1920	3529544.6055	518714.1224
IRS-1921	3527897.9036	516057.1663
IRS-1922	3527837.5033	516062.2731
IRS-1923	3529696.0545	518368.3411
IRS-1929	3528079.5054	515728.0622
IRS-1939	3527958.9319	516028.3211
IRS-1941	3527882.1122	515952.7837
IRS-1942	3527870.4529	516010.4907
IRS-1949	3529049.5765	520504.7872
IRS-1952	3530694.7629	519050.8756
IRS-1954	3527175.1216	516275.5440
IRS-1963	3527094.9820	516344.2409
IRS-1970	3530765.6159	518336.5406
IRS-1977	3529201.7802	518411.8732
IRS-1982	3527136.3648	516438.0917
IRS-1988	3530209.6743	518603.4188
IRS-1992	3529052.6379	518562.5878
IRS-1993	3530184.0813	518363.8737
IRS-2010	3537624.8573	522996.5031
IRS-2017	3538360.1997	523584.3768
IRS-2019	3527451.0247	516496.3191
IRS-2022	3531000.4084	518538.0647
IRS-2035	3527661.2504	516122.8872
IRS-2037	3539108.1022	523889.2964
IRS-2040	3539204.1128	523563.9135
IRS-2045	3539815.1170	515292.6144
IRS-2049	3523385.9343	515138.0861
IRS-2055	3540150.2610	515262.7360
IRS-2071	3539272.6148	512402.4682
IRS-2074	3540096.2360	515158.4396
IRS-2077	3539348.6091	513504.5078
IRS-2079	3524307.8507	510470.9345
IRS-2085	3539451.6316	512315.8156
IRS-2086	3539558.3454	512384.6456
IRS-2170	3523469.8804	511086.1053

Table E2 (continued). List of 345 Finite-IRS-25 to 1600-m IRS Target Points/AA Plots Sampled with location coordinates.

Target Point/Plot No.	UTM Y_projection	UTM X_projection
IRS-2176	3526115.9952	510258.9168
IRS-2283	3538374.5130	514389.3236
IRS-8548	3535397.0353	504581.1081
IRS-9000	3534659.9927	511443.5437
IRS-9901	3532544.1159	498154.2749

Supplement 2. Keys to Guadalupe Mountains National Park Plant Associations and Forms and Instructions for Accuracy Assessment Field Data Collection

This supplement contains the draft key used during the accuracy assessment and the forms and instructions for accuracy assessment field data collection.

Keys to Guadalupe Mountains National Park Plant Associations DRAFT

Este Muldavin

[Note: This is a copy of the key provided by the author, Este Muldavin, and used during the AA field data collection phase. No revisions have been made to this key for this report except where indicated by KHC. Other revisions will be made by the author].

The dichotomous keys to plant associations of Guadalupe Mountains National Park (GUMO) below use either explicitly specified cover values for indicator species as part of the decision rules in each step or specific adjectives that relate to species canopy cover as shown in Table E3. There are separate keys for the major classes (e.g., forests and woodlands, shrublands, etc.) as specified in the first key. Descriptions for each association can be found in Appendix C.

Table E3. Text descriptors for canopy cover and density with associated quantitative ranges definitions

Descriptor	Definition
Absent	Individuals are not found in stand.
Present	Individuals found in stand.
Accidental/Incidental	Individuals very infrequent, occasional, or limited to special microsites.
Scarce/Scattered (uncommon)	Canopy coverage < 1%.
Common	Canopy coverage > 1%.
Poorly Represented	Canopy coverage < 5%.
Well Represented	Canopy coverage >5%, but less than 10%.
Abundant	Canopy coverage >10%, but less than 25%.
Very Abundant	Canopy coverage > 25%, but less than 50%.
Luxuriant	Canopy coverage > 50%.
Dominant	Cover is greater than any other species of the same life form.
Codominant	Cover is as great as any other species of the same life form.
Regeneration	Understory trees represented by established seedlings and/or saplings.

Key to Major Vegetation Types

1. Trees dominant, typically >25% canopy cover; or if <25%, clearly the dominant and/or the characteristic growth form: ..... **KEY 1 – Forests and Woodlands**

1. Trees <10%, clearly not predominant: ..... (2)

2. Shrubs >25%, or if <25%, clearly the dominant and/or the characteristic growth form:..... **KEY 2 — Shrublands**

2. Shrubs usually <25%, herbs clearly the dominant and/or characteristic growth form: **KEY 3 – Herbaceous Vegetation**

KEY 1 – Forests and Woodlands

Key to Sub-types:

1. Forest and woodlands dominated by tall conifers and broadleaf trees that include *Pseudotsuga menziesii*, *Pinus strobiformis*, *Pinus ponderosa*, *Acer grandidentatum*, *Quercus muehlenbergii*, and/or *Populous deltoides*: **Sub-key 1A: Forests**

1. Woodlands dominated by short-statured conifer and broadleaf trees that include *Pinus edulis*, *Juniperus deppeana*, and *Quercus grisea*: **Sub-key 1B: Pinyon-Juniper-Oak Woodlands**

Sub-key 1A: Forests

1. The conifers *Pseudotsuga menziesii*, *Pinus strobiformis*, and/or *Pinus ponderosa* dominate or codominate the overstory; broadleaf tree may be common in the subcanopy: (2)

1. The broadleaf trees *Acer grandidentatum*, *Quercus muehlenbergii* or *Populous deltoides* dominate or codominate the overstory; conifers minor, clearly subordinate or absent from the canopy: (24)

2. *Pseudotsuga menziesii* dominant or codominant with *Pinus strobiformis* and/or *Pinus ponderosa*: (3)

2. *Pseudotsuga menziesii* absent or accidental: (12)

3. *Acer grandidentatum* well represented: (4)

3. *Acer grandidentatum* poorly represented or absent: (6)

4. *Quercus muehlenbergii* well represented: *Pseudotsuga menziesii - Acer grandidentatum -Quercus muehlenbergii* Forest

4. *Quercus muehlenbergii* absent or accidental: (5)

5. *Ostrya knowltonii* well represented in the sub-canopy: *Pseudotsuga menziesii - Acer grandidentatum -Ostrya knowltonii* Forest

5. *Quercus gambelii* well represented in the sub-canopy: *Pseudotsuga menziesii - Acer grandidentatum -Quercus gambelii* Forest

6. *Ostrya knowltonii* well represented: *Pseudotsuga menziesii - Ostrya knowltonii* Forest

6. *Ostrya knowltonii* absent or accidental: (7)

7. *Pinus strobiformis* well represented: *Pseudotsuga menziesii - Pinus strobiformis - Quercus gambelii* Forest

7. *Pinus strobiformis* absent or accidental: (8)

8. *Quercus gambelii* well represented with grassy understory: (9)

8. *Quercus gambelii* absent or accidental: (11)

9. *Muhlenbergia pauciflora* well represented to luxuriant in the understory: *Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest

9. *Muhlenbergia pauciflora* absent or accidental: (10)

10. *Piptochaetium fimbriatum* well represented to luxuriant in the understory: *Pseudotsuga menziesii - Quercus gambelii / Piptochaetium fimbriatum* Forest

10. *Festuca arizonica* well represented in the understory: *Pseudotsuga menziesii - Quercus gambelii / Festuca arizonica* Forest

11. *Muhlenbergia pauciflora* well represented to luxuriant in the understory: *Pseudotsuga menziesii / Muhlenbergia pauciflora* Forest

11. *Pseudotsuga menziesii* absent or accidental: (12)

12. *Pinus strobiformis* dominant; *Pinus ponderosa* and *Pseudotsuga menziesii* clearly subordinate: (13)

12. *Pinus ponderosa* dominant; *Pinus strobiformis* absent or accidental: (18)

13. *Acer grandidentatum* well represented: (14)

13. *Acer grandidentatum* poorly represented or absent: (16)

14. *Quercus muehlenbergii* well represented: *Pinus strobiformis - Acer grandidentatum - Quercus muehlenbergii* Forest

14. *Quercus muehlenbergii* absent or accidental: (15)

15. *Ostrya knowltonii* well represented in the sub-canopy: *Pinus strobiformis - Acer grandidentatum -Ostrya knowltonii* Forest

15. *Quercus gambelii* well represented in the sub-canopy: *Pinus strobiformis - Acer grandidentatum -Quercus gambelii* Forest

16. *Quercus muehlenbergii* well represented: *Pinus strobiformis - Quercus muehlenbergii* Forest

16. *Quercus muehlenbergii* absent or accidental: (17)

17. Populus tremuloides well represented: Populus tremuloides - *Pinus strobiformis* - *Ostrya knowltonii* Forest

17. *Festuca arizonica* well represented to luxuriant in the understory: *Pinus strobiformis* / *Festuca arizonica* Forest

18. *Pinus ponderosa* dominant; *Pinus strobiformis* and *Pseudotsuga menziesii* clearly subordinate: (19)

18. *Pinus ponderosa* and other tall conifers absent or accidental: (24)

19. *Acer grandidentatum* and/or *Quercus muehlenbergii* dominant or codominant: *Pinus ponderosa* - *Acer grandidentatum* - *Quercus muehlenbergii* Forest

19. *Acer grandidentatum* and/or *Quercus muehlenbergii* absent or accidental: (20)

20. *Quercus gambelii* well represented: (21)

20. *Quercus gambelii* absent or accidental: (22)

21. *Festuca arizonica* well represented to luxuriant; dominant in the understory: *Pinus ponderosa* - *Quercus gambelii* / *Festuca arizonica* Forest

21. *Piptochaetium fimbriatum* well represented to luxuriant; dominant in the understory: *Pinus ponderosa* / *Quercus gambelii* / *Piptochaetium fimbriatum* Forest

22. *Quercus* x *pauciloba* well represented: (23)

22. *Quercus* x *pauciloba* absent or accidental: unclassified conifer forest

23. *Muhlenbergia pauciflora* well represented to luxuriant; dominant in the understory: *Pinus ponderosa* / *Quercus* x *pauciloba* / *Muhlenbergia pauciflora* Forest

23. *Piptochaetium fimbriatum* well represented to luxuriant; dominant in the understory: *Pinus ponderosa* / *Quercus* x *pauciloba* / *Piptochaetium fimbriatum* Forest

24. *Acer grandidentatum* dominant or codominant: (25)

24. *Populous deltoides* the canopy dominant; *Acer grandidentatum* and/or *Quercus muehlenbergii* absent or accidental: *Populous deltoides* / *Muhlenbergia asperifolia* Forest

25. *Quercus muehlenbergii* codominant in the canopy: *Acer grandidentatum* - *Quercus muehlenbergii* Forest

25. *Quercus muehlenbergii* absent or accidental in the canopy: (26)

26. *Quercus gambelii* codominant in the canopy: *Acer grandidentatum - Quercus gambelii* Forest

26. *Quercus gambelii* absent or accidental in the canopy: *Acer grandidentatum - Quercus grisea* Forest Description and association name incongruent.

Sub-key 1B: Pinyon-Juniper-Oak Woodlands

1. *Pinus edulis* well represented to abundant and the dominant or codominant in the canopy (>25% of the total tree cover) (i.e., relative to *Juniperus* and *Quercus* sp.): (2)

1. *Pinus edulis* absent or accidental in the canopy (<25% of the total tree cover) (i.e., relative to *Juniperus* and *Quercus* sp.): (5)

2. *Piptochaetium fimbriatum* well represented and dominant in the understory and inter-tree spaces: *Pinus edulis - Juniperus deppeana / Piptochaetium fimbriatum* Woodland

2. *Piptochaetium fimbriatum* poorly represented, incidental, or absent: (3)

3. *Muhlenbergia setifolia* well represented and dominant in the understory and inter-tree spaces: *Pinus edulis / Muhlenbergia setifolia* Woodland

3. *Muhlenbergia setifolia* well poorly represented, incidental, or absent: (4)

4. *Muhlenbergia pauciflora* well represented and dominant in the understory and inter-tree spaces: *Pinus edulis / Muhlenbergia pauciflora* Woodland

4. *Bouteloua gracilis* well represented and dominant in the understory and inter-tree spaces; *Muhlenbergia pauciflora* poorly represented, incidental, or absent: *Pinus edulis* - (*Juniperus monosperma*, *Juniperus deppeana*) / *Bouteloua gracilis* Woodland

5. *Quercus grisea* well represented to abundant and the dominant or codominant in the canopy (>25% of the total tree cover) (i.e., relative to *Juniperus deppeana*); or can be shrub-like following fires but still codominant with *Juniperus deppeana*: (6)

5. *Quercus grisea* absent or accidental in the canopy: (9)

6. *Arbutus xalapensis* well represented in the subcanopy; grasses scattered and poorly represented: *Quercus grisea - Arbutus xalapensis* Woodland

6. *Arbutus xalapensis* poorly represented, incidental, or absent; grasses well represented to abundant: (7)

7. *Muhlenbergia emersleyi* dominates the understory an inter-tree spaces: *Quercus grisea - Juniperus deppeana / Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland

7. *Muhlenbergia emersleyi* uncommon or absent: (8)

8. *Piptochaetium fimbriatum* well represented and dominant in the understory and inter-tree spaces: *Quercus grisea - Juniperus deppeana* / *Piptochaetium fimbriatum* Woodland

8. *Muhlenbergia pauciflora* well represented and dominant in the understory and inter-tree spaces; *Piptochaetium fimbriatum* poorly represented, incidental, or absent: *Quercus grisea - Juniperus deppeana* / *Muhlenbergia pauciflora* Woodland

9. Shrubby *Quercus* x *pauciloba*, *Q. pungens*, or shrub-statured *Q. grisea* well represented the understory and inter-tree spaces; *Juniperus deppeana* / *Quercus* x *pauciloba* / *Bouteloua curtipendula* Woodland

9. *Quercus* x *pauciloba*,*Q. pungens*, or shrub-statured *Q. grisea* poorly represented or absent: (10)

10. *Bouteloua gracilis* dominates the understory and inter-tree spaces: *Juniperus deppeana* / *Bouteloua gracilis* Woodland

10. *Muhlenbergia pauciflora* dominates the understory and inter-tree spaces: *Juniperus deppeana* / *Muhlenbergia pauciflora* Woodland

KEY 2 — Shrublands

Key to Sub-types:

1. Shrublands dominated by montane and foothill shrubs including *Quercus gambelii*, *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea*, *Cercocarpus montanus*, *Juniperus pinchotii*, and/or *Robinia neomexicana*. **Sub-key 1A: Montane and Foothill Shrublands**

1. Shrublands dominated by desert shrubs that include *Acacia neovernicosa*, *Atriplex canescens*, *Chilopsis linearis*, *Fallugia paradoxa*, *Flourensia cernua*, *Larrea tridentata*, *Juglans microcarpa*, *Mimosa aculeaticarpa* var. *biuncifera*, *Mortonia scabrella*, *Prosopis glandulosa*, *Psorothamnus scoparius*, *Sartwellia flaveriae*, *Tiquilia greggii*, and *Viguiera stenoloba*, among others: **Sub-key 1B: Desert Shrublands**

Sub-key 1A: Montane and Foothill Shrublands

1. *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea*, *Cercocarpus montanus*, and/or *Juniperus pinchotii*, dominate the shrub layer: (2)

1. *Quercus gambelii* or *Robinia neomexicana* the dominant shrubs: (11)

2. *Juniperus pinchotii* well represented, often codominant with shrubby *Quercus* spp. The herbaceous layer is grassy and dominated by *Muhlenbergia setifolia*: *setifolia* Woodland *Juniperus pinchotii* / *Q. pungens* (*Quercus* x *pauciloba*) / *Muhlenbergia setifolia* Woodland Note, KHC: This is the current name in the GUMO classification. *Q. pungens* was chosen to conform with the CAVE classification. Other scrub oaks will be part of the descriptions. Este M. will look at this further after the season.

2. *Juniperus pinchotii* uncommon or absent: (3)

3. *Quercus* x *pauciloba*, *Q. pungens*, or shrub-statured *Q. grisea* dominant or codominant with *Cercocarpus montanus*: (4)

3. *Cercocarpus montanus* the dominant shrub; *Quercus* x *pauciloba*, *Q. pungens*, or shrub-statured *Q. grisea* clearly subordinate, poorly represented or absent: (9)

4. Shrub understory and inter-shrub spaces dominated or codominated by *Achnatherum lobatum*: *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Achnatherum lobatum* Shrubland. Note, KHC: The current name is "*Quercus* x *pauciloba*/*Achnatherum lobatum* Scrubland." Este M. will review against regional plot data.

4. *Achnatherum lobatum* uncommon or absent: (5)

5. Shrub understory and inter-shrub spaces dominated or codominated by *Muhlenbergia emersleyi*:) *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Muhlenbergia emersleyi* Shrubland. Note: Current name "*Quercus pungens* (*Q.* x *pauciloba*) / *Muhlenbergia emersleyi* Scrubland. " Note, KHC: Este M. will review against regional plot data.

5. *Muhlenbergia emersleyi* uncommon or absent: (6)

6. Shrub understory and inter-shrub spaces dominated by *Muhlenbergia setifolia*: *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Muhlenbergia setifolia* Shrubland. Note, KHC: Este M. will review against regional plot data.

6. *Muhlenbergia setifolia* uncommon or absent: (7)

7. Shrub understory and inter-shrub spaces dominated by *Muhlenbergia pauciflora*: *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Muhlenbergia pauciflora* Shrubland. Note, KHC: Este M. will review against regional plot data.

7. *Muhlenbergia pauciflora* uncommon or absent: (8)

8. Shrub understory and inter-shrub spaces dominated by *Bouteloua gracilis*: *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Bouteloua gracilis* Shrubland. Note, KHC: Este M. will review against regional plot data.

8. *Bouteloua gracilis* absent, other grasses generally sparse and scattered; *Cercocarpus montanus* \clear codominant shrub creating as dense shrub layer: *Quercus* x *pauciloba*, *Q. pungens*, shrub-statured *Q. grisea* / *Cercocarpus montanus* Shrubland. Note, KHC: Este M. will review against regional plot data.

9. *Cercocarpus montanus* the dominant shrub: (10)

9. *Quercus gambelii* or *Robinia neomexicana* the dominant shrubs: (11)

10. Shrub understory and inter-shrub spaces dominated by *Muhlenbergia pauciflora*: *Cercocarpus montanus* / *Muhlenbergia pauciflora* Shrubland

10. Shrub understory and inter-shrub spaces dominated by *Muhlenbergia setifolia*: *Cercocarpus montanus* / *Muhlenbergia setifolia* Shrubland

11. *Quercus gambelii* the dominant shrub; *Robinia neomexicana* codominant or absent: (12)

11. *Quercus gambelii* poorly represented or absent: (14)

12. Shrub understory and inter-shrub spaces understory grassy, dominated by *Piptochaetium fimbriatum* and/or *Festuca arizonica*: *Quercus gambelii* / *Piptochaetium fimbriatum - Festuca arizonica* Woodland

12. *Piptochaetium fimbriatum* or *Festuca arizonica* poorly represented or absent; (13)

13. *Robinia Neomexicana* codominant well-represented to luxuriant: *Quercus gambelii* / *Robinia neomexicana* Shrubland

13. *Robinia Neomexicana* incidental or absent in shrub understory and inter-shrub spaces sparse with scattered forbs and graminoids such as *Carex inops*: *Quercus gambelii* / *Carex inops* Shrubland

14. *Robinia Neomexicana* dominant and luxuriant; shrub understory and inter-shrub spaces may be grassy and dominated by *Piptochaetium fimbriatum*, *Festuca arizonica*, and other montane grasses or they may be sparse: *Robinia neomexicana* / *Piptochaetium fimbriatum* Shrubland

14. *Robinia Neomexicana* absent: unclassified shrubland

Sub-key 1B: Desert Shrublands

1. *Larrea tridentata* is the dominant or codominant shrub: (2)

1. *Larrea tridentata* is not the dominant shrub: (11)

2. Shrub understories and inter-shrub spaces grassy: (3)

2. Shrub understories and inter-shrub spaces sparse or dominated by subshrubs succulents, or are sparse: (8)

3. *Bouteloua eriopoda* well- represented and dominant: *Larrea tridentata* / *Bouteloua eriopoda* Shrubland

3. *Bouteloua eriopoda* uncommon or absent: (4)

4. *Bouteloua gracilis* well- represented and dominant: *Larrea tridentata* / *Bouteloua gracilis* Shrubland

4. *Bouteloua gracilis* uncommon or absent: (5)

5. *Muhlenbergia porteri* and *Setaria leucopila* well represented and dominant: *Larrea tridentata* / *Muhlenbergia porteri* Shrubland

5. *Muhlenbergia porteri* and *Setaria leucopila* uncommon, clearly incidental, or absent: (6)

6. Understory and inter-shrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: *Larrea tridentata* / *Sporobolus airoides* Shrubland

6. *Sporobolus airoides* poorly represented or absent: (7)

7. Understory and inter-shrub spaces dominated by *Sporobolus flexuosus* or *S. contractus*; usually sandy sites: *Larrea tridentata* / *Sporobolus flexuosus* Shrubland

7. *Sporobolus flexuosus* poorly represented or absent; Graminoids poorly represented, inter-shrub spaces dominated by subshrubs, succulents, or sparse: (8)

8. *Krameria grayi* well represented and usually the dominant sub-shrub: *Larrea tridentata* - *Krameria grayi* Shrubland

8. *Krameria grayi* uncommon, clearly incidental, or absent: (9)

9. *Parthenium incanum* dominates the inter-shrub spaces along with a variety of other subshrubs and succulents: *Larrea tridentata* - *Parthenium incanum* Shrubland

9. Subshrubs and succulents scattered and sparse in the inter-shrub spaces: (10)

10. *Flourensia cernua* codominant shrub: *Larrea tridentata* - *Flourensia cernua* / Sparse Shrubland

10. *Flourensia cernua* uncommon, clearly incidental, or absent: *Larrea tridentata* / Sparse Understory Shrubland

11. *Flourensia cernua* the dominant shrub: (12)

11. *Flourensia cernua* poorly represented or absent: (13)

12. Graminoid cover is well represented to luxuriant and dominated by *Muhlenbergia porteri* and/or *Setaria leucopila*: *Flourensia cernua* / *Muhlenbergia porteri* Shrubland

12. Cover in inter-shrub spaces otherwise or sparse: *Flourensia cernua* Shrubland [Provisional]

13. *Psorothamnus scoparius* common, the dominant or codominant shrub: *Psorothamnus scoparius* / *Sporobolus flexuosus* Shrubland

13. *Psorothamnus scoparius* uncommon or absent, clearly incidental: (14)

14. *Poliomintha incana* common the dominant or codominant shrub: (15)

14. *Poliomintha incana* uncommon or absent: (17)

15. Graminoid cover typically well represented and dominated by *Bouteloua breviseta*; gypsophilous soils: *Poliomintha incana* / *Bouteloua breviseta* Gypsophilous Shrubland

15. *Bouteloua breviseta* uncommon or absent: (16)

16. Graminoid cover dominated by *Andropogon hallii*; dunelands: *Poliomintha incana* / *Andropogon hallii* Shrubland

16. *Andropogon hallii* absent or incidental; graminoids scattered and dominated by *Sporobolus flexuosus*: *Poliomintha incana* / *Sporobolus flexuosus* Shrubland

17. *Acacia neovernicosa* common the dominant or codominant shrub: (18)

17. *Acacia neovernicosa* uncommon, incidental or absent: (19)

18. Graminoid cover usually well represented and dominated by *Bouteloua eriopoda*: *Acacia neovernicosa* / *Bouteloua eriopoda* Shrubland

18. Graminoid cover poorly represented, scattered; sites typically dominated by succulents and subshrubs: *Acacia neovernicosa - Agave lechuguilla* Shrubland

19. *Mimosa aculeaticarpa* var. *biuncifera* well represented, the dominant shrub; sites often grassy: *Mimosa aculeaticarpa* var. *biuncifera* / *Bouteloua curtipendula* Shrubland

19. *Mimosa aculeaticarpa* var. *biuncifera* absent or incidental: (20)

20. *Mortonia scabrella* well represented, the dominant shrub or subshrub: *Mortonia scabrella - Parthenium incanum* Shrubland

20. *Mortonia scabrella* absent or incidental: (21)

21. *Viguiera stenoloba* well represented, the dominant shrub: *Viguiera stenoloba* / *Parthenium incanum* Shrubland

21. *Viguiera stenoloba* absent or incidental: (22)

22. *Fouquieria splendens* at least common, conspicuous dominant or codominant shrub: (23)

22. *Fouquieria splendens* absent or incidental: (24)

23. *Tiquilia greggii* common to well represented, usually the dominant subshrub: *Fouquieria splendens - Tiquilia greggii* Shrubland

23. *Tiquilia greggii* absent or incidental, *Parthenium incanum* usually well represented to abundant: *Fouquieria splendens* / *Parthenium incanum* Shrubland. Note, KHC: Use of "/" is incorrect but this the official name for the moment in the NVC database. Este M. will address.

24. *Atriplex canescens* the dominant shrub: (25)

24. *Atriplex canescens* is not the dominant shrub: (30)

25. *Sporobolus nealleyi*, *Sartwellia flaveriae* and other gypsophiles common, conspicuous indicators gypsum soils: (26)

25. *Sporobolus nealleyi*, *Sartwellia flaveriae* and other gypsophiles uncommon or absent: (28)

26. *Sporobolus nealleyi* the dominant grass: *Atriplex canescens* / *Sporobolus nealleyi* Shrubland

26. *Sporobolus nealleyi* uncommon, or absent: (27)

27. *Sartwellia flaveriae* usually well represented along with other gypsophiles: (28)

27. *Sartwellia flaveriae* and other gypsophiles uncommon or absent: (29)

28. *Muhlenbergia porteri* the dominant grass: *Atriplex canescens* / *Muhlenbergia porteri - Sartwellia flaveriae* Shrubland. Note, KHC: Use of "/" is incorrect but this the official name for the moment in the NVC database. Este M. will try to get it changed.

28. *Muhlenbergia porteri* uncommon or absent; *Sporobolus airoides* the dominant grass: *Atriplex canescens* / *Sporobolus airoides* / *Sartwellia flaveriae* Shrubland

29. Understory and inter-shrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: *Atriplex canescens* / *Sporobolus airoides* Shrubland

29. *Sporobolus airoides* poorly represented or absent understory and inter-shrub spaces dominated by *Sporobolus flexuosus*, usually sandy sites: *Atriplex canescens* / *Sporobolus contractus* Shrubland

30. *Prosopis glandulosa* clearly dominant: (31)

30. *Prosopis glandulosa* usually poorly represented, incidental, or absent: (33)

31. Understory and inter-shrub spaces dominated by *Sporobolus airoides*, usually bottomland clay sites: *Prosopis glandulosa* / *Sporobolus airoides* Shrubland

31. *Sporobolus airoides* poorly represented or absent: (32)

32. Understory and inter-shrub spaces dominated by *Sporobolus flexuosus*, usually sandy sites: *Prosopis glandulosa* / *Sporobolus flexuosus* Shrubland

32. *Sporobolus flexuosus* poorly represented or absent; ephemeral desert wash sites with scattered shrubs: *Prosopis glandulosa* - Dry Wash Shrubland

33. *Juglans microcarpa* well represented and codominant with *Juglans microcarpa - Fallugia paradoxa / Bouteloua curtipendula* Forested Wetland

33. *Juglans microcarpa* poorly represented, incidental or absent: (34)

34. *Ungnadia speciosa1* well represented and codominant with *Fallugia paradoxa*: *Fallugia paradoxa - Ungnadia speciosa* Shrubland

34. *Ungnadia speciosa* poorly represented, incidental or absent: (35)

35. *Chilopsis linearis* well represented and codominant with *Fallugia paradoxa*: *Chilopsis linearis - Fallugia paradoxa* Shrubland

35. *Chilopsis linearis* poorly represented, incidental or absent: (36)

36. *Brickellia laciniata* well represented and codominant with *Fallugia paradoxa - Brickellia laciniata* Shrubland

36. *Brickellia laciniata* poorly represented, incidental or absent: *Fallugia paradoxa* Arroyo Wash Shrubland

KEY 3 – Herbaceous Vegetation

1. *Festuca arizonica* well represented to abundant, the dominant or codominant grass: *Festuca arizonica - Bouteloua gracilis* Herbaceous Vegetation

1. *Festuca arizonica* poorly represented, incidental, or absent: (2)

2. *Achnatherum lobatum* well represented to abundant, dominant or codominant: *Achnatherum lobatum - Bouteloua curtipendula* Herbaceous Vegetation

2. *Achnatherum lobatum* poorly represented, incidental, or absent: (3)

3. *Nassella tenuissima* well represented to abundant, dominant or codominant: *Nassella tenuissima - Bouteloua gracilis* Herbaceous Vegetation

3. *Nassella tenuissima* poorly represented, incidental, or absent: (4)

4. *Muhlenbergia pauciflora* well represented to abundant, dominant or codominant: *Viguiera stenoloba / Muhlenbergia pauciflora* Shrub Herbaceous Vegetation

4. *Muhlenbergia pauciflora* poorly represented, incidental, or absent: (5)

5. *Muhlenbergia emersleyi* well represented to abundant, dominant or codominant: (6)

5. *Muhlenbergia emersleyi* poorly represented, incidental, or absent: (7)

6. *Nolina microcarpa* usually well represented, the dominant shrub: *Nolina texana* / *Muhlenbergia emersleyi* Shrub Herbaceous Vegetation. Note, KHC: Description and name incongruent but keep until Este M. revises.

6. *Dasylirion leiophyllum* usually well represented, the dominant shrub: *Dasylirion leiophyllum* / *Muhlenbergia emersleyi* Shrub Herbaceous Vegetation

7. *Muhlenbergia setifolia* well represented to abundant, dominant or codominant: (8)

7. *Muhlenbergia setifolia* poorly represented, incidental, or absent: (12)

8. *Bouteloua eriopoda* well represented to abundant, codominant: *Muhlenbergia setifolia - Bouteloua eriopoda* Herbaceous Vegetation

8. *Bouteloua eriopoda* poorly represented, incidental, or absent: (9)

9. *Nolina microcarpa* usually well represented, the dominant shrub: *Nolina texana* / *Muhlenbergia setifolia* Shrub Herbaceous Vegetation. Note, KHC: Description and name incongruent but keep until Este M. revises.

9. *Nolina microcarpa* poorly represented, not dominant or codominant among shrubs: (10)

10. *Dasylirion leiophyllum* usually well represented, the dominant shrub: (11)

10. *Dasylirion leiophyllum* poorly represented, incidental, or absent: *Muhlenbergia setifolia - Bouteloua eriopoda* Herbaceous Vegetation

11. *Agave lechuguilla* common: *Agave lechuguilla - Dasylirion leiophyllum* / *Muhlenbergia setifolia* Shrub Herbaceous Vegetation

11. *Agave lechuguilla* uncommon, incidental, or absent: *Dasylirion leiophyllum* / *Muhlenbergia setifolia* Shrub Herbaceous Vegetation

12. *Hesperostipa neomexicana* well represented to abundant, dominant or codominant: (13)

12. *Hesperostipa neomexicana* poorly represented, incidental, or absent: (14)

13. *Dasylirion leiophyllum* usually well represented, the dominant shrub: *Hesperostipa neomexicana - Dasylirion wheeleri* Herbaceous Vegetation. Note, KHC: Description and name incongruent but keep until Este M. revises.

13. *Dasylirion leiophyllum* poorly represented, incidental, or absent: *Hesperostipa neomexicana - Bouteloua curtipendula* Herbaceous Vegetation

14. *Bouteloua eriopoda* well represented to abundant, dominant or codominant: (15)

14. *Bouteloua eriopoda* poorly represented, incidental, or absent: (27)

15. Shrubs, subshrubs, and succulents well represented, significant components of the stands (shrub-steppes): (16)

15. Shrubs, subshrubs, and succulents poorly represented, incidental; not a significant structural element: (23)

16. *Nolina microcarpa* common to abundant: *Nolina texana* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation. Note, KHC: Description and name incongruent but keep until Este M. revises.

16. *Nolina microcarpa* poorly represented or absent: (17)

17. *Yucca elata* common to well represented, the dominant shrub: (18)

17. *Yucca elata* uncommon, not dominant or codominant among shrubs: (19)

18. *Bouteloua gracilis* a codominant grass: *Yucca elata* / *Bouteloua eriopoda - Bouteloua gracilis* Shrub Herbaceous Vegetation

18. *Bouteloua gracilis* uncommon, incidental, clearly not codominant: *Yucca elata* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation

19. *Yucca torreyi* common to well represented, the dominant shrub: *Yucca torreyi* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation

19. *Yucca torreyi* uncommon, not dominant or codominant among shrubs: (20)

20. *Fouquieria splendens* well represented to abundant, the conspicuous dominant shrub: *Fouquieria splendens* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation

20. *Fouquieria splendens* poorly represented, not dominant or codominant among shrubs: (21)

21. *Viguiera stenoloba* well represented to abundant, the dominant shrub: *Viguiera stenoloba* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation

21. *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: (22)

22. *Agave lechuguilla* well represented to abundant, the dominant subshrub: *Agave lechuguilla* / *Bouteloua eriopoda* Dwarf-shrubland

22. *Agave lechuguilla* poorly represented, not dominant or codominant among subshrubs: (23)

23. *Parthenium incanum* well represented to abundant, the codominant subshrub: *Parthenium incanum* / *Bouteloua eriopoda* Dwarf-shrubland

23. *Parthenium incanum* poorly represented, shrubs and subshrubs scattered, incidental: (24)

24. *Hesperostipa neomexicana* well represented to abundant, codominant: *Bouteloua eriopoda - Hesperostipa neomexicana* Herbaceous Vegetation

24. *Hesperostipa neomexicana* poorly represented, incidental, or absent: (25)

25. *Muhlenbergia porteri* well represented to abundant, codominant: *Bouteloua eriopoda - Muhlenbergia porteri* Herbaceous Vegetation

25. *Muhlenbergia porteri* poorly represented, incidental, or absent: (26)

26. *Bouteloua gracilis* well represented to abundant, dominant or codominant: *Bouteloua eriopoda - Bouteloua gracilis* Herbaceous Vegetation

26. *Bouteloua curtipendula* codominant; *Bouteloua gracilis* poorly represented, incidental, or absent: *Bouteloua eriopoda - Bouteloua curtipendula* Herbaceous Vegetation

27. *Bouteloua gracilis* well represented to abundant, dominant or codominant: (28)

27. *Bouteloua gracilis* poorly represented, incidental, or absent: (32)

28. *Viguiera stenoloba* well represented to abundant, the dominant shrub: *Viguiera stenoloba* / *Bouteloua gracilis* Shrub Herbaceous Vegetation

28. *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: (29)

29. *Panicum obtusum* well represented to abundant, codominant: *Bouteloua gracilis - Panicum obtusum* Herbaceous Vegetation

29. *Panicum obtusum* poorly represented, incidental, or absent: (30)

30. *Bouteloua curtipendula* well represented to abundant, codominant: *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation

30. *Bouteloua curtipendula* poorly represented, incidental, or absent: (31)

31. *Gutierrezia sarothrae* well represented to abundant, the dominant subshrub: *Gutierrezia sarothrae* / *Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation

31. *Gutierrezia sarothrae* poorly represented, stands dominated by annual and perennial ruderal forbs: *Bouteloua gracilis* / Ruderal Herbaceous Vegetation

32. *Bouteloua curtipendula* well represented to abundant, dominant or codominant: (33)

32. *Bouteloua curtipendula* poorly represented, incidental, or absent: (35)

33. *Fouquieria splendens* well represented to abundant, the conspicuous dominant shrub: *Fouquieria splendens* / *Bouteloua curtipendula* Shrub Herbaceous Vegetation

33. *Fouquieria splendens* poorly represented, not dominant or codominant among shrubs: (34)

34. *Viguiera stenoloba* well represented to abundant, the dominant shrub: *Viguiera stenoloba* / *Bouteloua curtipendula* Shrub Herbaceous Vegetation

34. *Dasylirion leiophyllum* usually well represented, the dominant shrub; *Viguiera stenoloba* poorly represented, not dominant or codominant among shrubs: *Dasylirion leiophyllum* / *Bouteloua curtipendula* Shrub Herbaceous Vegetation

35. *Krameria grayi* well represented to abundant, the codominant subshrub: *Krameria grayi* / *Dasyochloa pulchella* Dwarf-shrub Herbaceous Vegetation

35. *Krameria grayi* poorly represented, shrubs and subshrubs scattered, incidental: (36)

36. *Tiquilia hispidissima*, *Bouteloua breviseta*, *Sporobolus nealleyi* and other gypsophiles common, conspicuous indicators gypsum soils: (37)

36. *Tiquilia hispidissima*, *Bouteloua breviseta*, *Sporobolus nealleyi* and other gypsophiles uncommon or absent: (41)

37. *Tiquilia hispidissima* well represented to abundant, the codominant subshrub: (38)

37. *Tiquilia hispidissima* poorly represented, shrubs and subshrubs scattered, incidental: (41)

38. *Bouteloua breviseta* well represented to abundant, dominant or codominant: *Tiquilia hispidissima* / *Bouteloua breviseta - Sporobolus nealleyi* Shrub Herbaceous Vegetation

38. *Bouteloua breviseta* poorly represented, incidental, or absent: (39)

39. *Sporobolus nealleyi* well represented to abundant, dominant or codominant: *Tiquilia hispidissima* / *Sporobolus nealleyi* Shrub Herbaceous Vegetation

39. *Sporobolus nealleyi* poorly represented, incidental, or absent: (40)

40. *Dasyochloa pulchella* well represented to abundant, dominant or codominant: *Tiquilia hispidissima* / *Dasyochloa pulchella* Dwarf-shrub Herbaceous Vegetation

40. *Dasyochloa pulchella* poorly represented, incidental, or absent: *Tiquilia hispidissima* / *Sartwellia flaveriae* Dwarf-shrubland

41. *Bouteloua breviseta* well represented to abundant, dominant or codominant: *Ephedra torreyana* / *Bouteloua breviseta* Dwarf-shrub Herbaceous Vegetation

41. *Sporobolus nealleyi* well represented to abundant; codominant with *Sporobolus airoides*; *Bouteloua breviseta* poorly represented, incidental, or absent: *Sporobolus nealleyi* - *Sporobolus airoides* Herbaceous Vegetation

42. *Sporobolus airoides* well represented to abundant, dominant in near monotypic stands: *Sporobolus airoides* Monotype Herbaceous Vegetation

42. *Sporobolus airoides* poorly represented, incidental, or absent

43. Stands dominated by *Setaria leucopila* and other ruderal grasses and forbs: *Setaria leucopila* / *Solanum elaeagnifolium* Herbaceous Vegetation

43. Stands dominated by facultative and obligate wetland species including *Schoenoplectus americanus*: *Schoenoplectus americanus* Western Herbaceous Vegetation

Accuracy Assessment Forms

Figures E3–E6 are example accuracy assessment forms.

INSTRUCTIONS - 2013 ACCURACY ASSESSMENT FORM – GUMO

General Information:

AA Point Code: GUMO_AA_IRS # This is the target point number on the map to which you have navigated.

SITE NAME: Identify the part of the park you are in (i.e., Basin, Brokeoffs, west slope of Bush Mountain, etc.) for GPS verification).

SURVEYORS: Record First name initial, Last name written out in full (circle names making plant association)

Locational Data:
WAYPOINT: Mark the waypoint number displayed on the GPS unit display.
GPS Unit ID: Record a unique identifier for the GPS Unit your team is using to distinguish it from any other GPS unit being used.
GPS Unit Make and Model: _____

Plot Size, Shape and Dimensions:
Plant Association Size: The Plant Association at the AA Target Point should occupy an area of at least 0.5 hectare (ha).
Size and Shape of AA Plot: Record Plot Shape, Size (ha) and Dimensions. The preferred size of the AA Plot is 0.5 hectare. The preferred AA Plot shape is a circle with a radius of 40 m from the center of the target point. Rectangular and square plots (measuring 0.5 ha) may also be used where necessary to fit the plant association. In Forests and Graminoid Vegetation (see below), smaller AA plots (circle, rectangle, square) can be used where warranted:

VEGETATION PHYSIOGNOMIC CATEGORY	MMU RANGE (OBS. AREA SIZE)
Forests	0.25 to 1.0 hectare
Woodlands, Shrublands and Wooded Shrublands	0.5 to 2.0 hectare
Herbaceous and Graminoid Vegetation	0.1 to 0.5 hectares

OBSERVATION AREA SIZE	AA OBS. AREA RADIUS LENGTH
0.1 hectare (1,000 $m^{2)}$	18 meters
0.25 hectare (2,500 $m^{2)}$	28 meters
0.5 hectare (5,000 m^2)	40 meters
1.0 hectare (10,000 m^2)	56 meters
2.0 hectare (20,000 m^2)	80 meters

PHOTO DOCUMENTATION Photographer: _____

Take a minimum of 5 images per AA Plot standing at the target point in the center of the AA Plot. Take photos in the order listed below. The Datasheet Image photo should contain a clearly-focused, readable close up of the first two boxes of the data sheet with the locational information filled in. This will be matched later with the hard copy of the field datasheet for data processing. The Image ID# is the number of the photo displayed on your camera screen. For each plot image, allow for the top 10% (minimum) of the photo to be sky. Record the azimuth (0-360°) of the direction of each slope (i.e. upslope, cross-alope) you photograph. At your discretion, use the remaining slots on the datasheet for photos that show the plot within the context of the landscape, especially if this is not captured by the plot documentation images. Use the extra space to record images of photo vouchers of plants that need identification, especially any unidentified oaks. (Get a close up of the leaves and any reproductive parts). A photo voucher can also be used in place of a plant specimen collection.

Image Slope	Image ID#	Azimuth (0-360°)	Comments
Datasheet Image		N/A	
Upslope			
Cross-slope (right)			
Downslope			
Cross-slope (left)			

ENVIRONMENTAL DESCRIPTION

Slope: _____ degrees
Use the clinometer to record the percent (0 -300+ %) slope.
Flat (0%) Steep (50-100%)
Gentle (1-9%) Very Steep (101-275%)
Moderate (10-25%)) Abrupt (276-300%)
Somewhat Steep (26-49%) Overhanging (>300%)

Azimuth of slope _____ degrees
Use the compass to record the azimuth of the slope (0-360 degrees).

1

Figure E3. Example of page 1 instructions for 2013 accuracy assessment form for Guadalupe Mountains NP.

INSTRUCTIONS - 2013 ACCURACY ASSESSMENT FORM – GUMO

PLANT ASSOCIATION AT AA POINT (based on classification key and within plot dimensions of target point
Using the Plant Association Key, determine the Primary Association Name and if present, the Secondary Association Name.

Primary Association by Name: (*i.e., Pseudotsuga menziesii - Quercus gambelii / Muhlenbergia pauciflora* Forest)
Secondary Association by Name: _____
Classification Comments: Describe special conditions that may have been encountered (**Circle all that apply and briefly describe**): field key did not work, unusual vegetation conditions that may affect the identification of type, secondary field call (if significant ambiguity about primary field call), obviously undescribed vegetation type, other).

DOMINANT VEGETATION BY COVER CLASS – For each Stratum (Trees, Shrubs, Graminoids, Dwarf Shrubs) in the AA Plot,

1) Record the percent cover (%) of each stratum (i.e., Trees = 70%, Graminoids = 50%) in the plot.

2) Record the percent cover (%) of the two dominant species (i.e., see examples T1 and T2, below) in each stratum. Record using the numbers in the Cover Scale Legend, below. If two species are co-dominant based on the Cover Scale Legend numbers (i.e., note that T1 & T2 are both "7"), list the third most dominant species also (i.e., see example T3, below). Note: Do not record Herbaceous Plants or Forbs.

Tree Stratum Total Cover of Trees in Plot 70%	Cover Scale*	**Graminoid Statum** – Total Cover of Graminoids in Plot 50%	Cover Scale
T1 ***Pseudotsuga menziesii*** **(30% cover in plot)**	7	G1 ***Muhlenbergia pauciflora*** **(45 % cover in plot)**	10
T2 ***Pinus ponderosa*** **(25% cover in plot)**	7	G2 ***Festuca arizonica*** **(5% cover in plot)**	4
T3 ***Acer grandidentatum*** **(10% cover in plot)**	5	G3	
Shrub Stratum (>0.5m – 5m) Total Cover of Shrubs in Plot 25%	Cover Scale*	**Dwarf Shrub Stratum (<0.5m)** Total Cover of Dwarf Shrubs in Plot……0%	Cover Scale*
S1 ***Quercus gambelli*** **(25% cover in plot)**	6	DS1	0
S2		DS2	
S3		DS3	

***Cover Scale Legend:**

1=	trace (1-3 plants)	**6**=	10-25%
2=	few to frequent, but scattered (>3 plants but <1% cover)	**7**=	25-50%
		8=	50-75%
3=	1-2%	**9**=	75-95%
4=	2-5%	**10**=	95-100%
5=	5-10%		

Vouchers: Vouchers are collected if a new species is found on the project or to help with the identification of a plant whose identity is uncertain. If a voucher specimen is collected, please record using the table below. If possible, photograph the plants you collect, especially leaves and reproductive parts to aid identification.

Vouchers Collected: LIST Taxon name and I.D. with Unique Number:

Taxon	I.D. #	Verified I.D. Taxon Name
General Comments:		

Figure E4. Example of page 2 instructions for 2013 accuracy assessment form for Guadalupe Mountains NP..

2014 ACCCURACY ASSESSMENT FORM-GUMO

AA Point Code: GUMO_AA_IRS #_____

SITE NAME: _____(for GPS verification)

DATE: MO _____**DAY**_____ **YEAR 2014** **Time:**_____

SURVEYORS: _____(circle names making plant association)

WAYPOINT: _____**GPS Unit ID:** _____

UTM Zone: 13 **Datum:** NAD83 **GPS Unit Make and Model:** **Garmin Montana 650t**

UTM: EASTING _____ **NORTHING** _____**GPS Error** _____**m or ft**

ELEV _____**m** **# Satellites** _____

ENVIRONMENTAL DESCRIPTION:

Slope:_____**% (0-90%)(Use a clinometer)** **Azimuth of slope:**_____**degrees (0-360 °)**

PLOT INFORMATION:
Plot Shape (circle one): **circle or rectangle or square**

Plot Size:_____**(ha)** **Dimensions: Length =**_____**m x Width =**_____**m / or radius =**_____ **m**

PHOTO DOCUMENTATION Photographer: _____

Image	Image ID#	Azimuth (degrees)	Comments
Datasheet Image		N/A	
Upslope			
Cross-slope (right)			
Downslope			
Cross-slope (left)			

1

Figure E5. Example of page 1 of the 2014 accuracy assessment form for Guadalupe Mountains NP..

2014 ACCCURACY ASSESSMENT FORM-GUMO

WAYPOINT: _____

PLANT ASSOCIATION AT AA POINT

Based on Classification Key and within plot dimensions of AA target point: **Primary Association by Name:** _____
Secondary Association by Name: _____
Classification Comments: Description of special conditions that may have been encountered (**Circle all that apply**): field key did not work, unusual vegetation conditions that may affect the identification of type, secondary field call (if significant ambiguity about primary field call), obviously undescribed vegetation type, other).

DOMINANT VEGETATION BY COVER CLASS			
Tree Stratum Total % Cover of Trees in plot _____%	Cover Scale*	Graminoid Stratum Total % Cover of Graminoids in plot _____%	Cover Scale
T1		G1	
T2		G2	
T3		G3	
Shrub Stratum (>0.5m – 5m) Total % Cover of Shrubs in plot _____%	Cover Scale*	Dwarf Shrub Stratum (<0.5m) Total % Cover of Dwarf Shrubs in plot _____%	Cover Scale*
S1		DS1	
S2		DS2	
S3		DS3	

*Cover Scale Legend:

1=	trace (1- 3 plants)		
2=	few to frequent but scattered (>3 plants but <1% cover)	6=	10-25%
		7=	25-50%
3=	1-2%	8=	50-75%
4=	2-5%	9=	75-95%
5=	5-10%	**10**=	95-100%

Vouchers Collected: LIST Taxon name and I.D. with Unique Number:

Taxon	**I.D. #**	**Verified I.D. Taxon Name**
General Comments:		

2

Figure E6. Example of page 2 of the 2014 accuracy assessment form for Guadalupe Mountains NP..

Supplement 3. AA Plot/Target Points and Plant Association

Table E4 shows the list of AA plot/target points and Guadalupe Mountains NP plant associations (Muldavin 2013).

Table E4. AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0002	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUM0_0012	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0016	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0018	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0021	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0033	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0040	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0045	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0047	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0048	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0052	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0054	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0057	*Sporobolus nealleyi-Sporobolus airoides* Herbaceous Vegetation	NA
GUMO_0058	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Sporobolus airoides* Monotype Herbaceous Vegetation
GUMO_0061	*Sporobolus nealleyi-Sporobolus airoides* Herbaceous Vegetation	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland
GUMO_0062	*Sporobolus nealleyi-Sporobolus airoides* Herbaceous Vegetation	–
GUMO_0064	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Sporobolus nealleyi-Sporobolus airoides* Herbaceous Vegetation
GUMO_0070	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0071	*Sporobolus airoides* Monotype Herbaceous Vegetation	NA
GUMO_0076	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0082	*Sporobolus airoides* Monotype Herbaceous Vegetation	NA
GUMO_0085	*Atriplex canescens/Sporobolus airoides* Shrubland	NA
GUMO_0087	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Sporobolus airoides* Monotype Herbaceous Vegetation

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0095	*Sporobolus airoides* Monotype Herbaceous Vegetation	NA
GUMO_0097	*Tiquilia hispidissima/Sartwellia flaveriae* Dwarf-Shrubland	NA
GUMO_0105	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0112	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0114	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0118	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0119	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0126	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0131	*Larrea tridentata/Sprorobolus airoides* Shrubland	NA
GUMO_0134	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0144	*Atriplex canescens/Sporobolus nealleyi* Shrubland	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland
GUMO_0149	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0150	*Tiquilia hispidissima/Sporobolus neallyi* Shrub Herbaceous Vegetation	NA
GUMO_0157	*Ephedra torreyana/Bouteloua breviseta* Dwarf-shrub Herbaceous Vegetation	*Poliomintha incana/Bouteloua breviseta* Gypsophilous Shrubland
GUMO_0167	*Psorothamnus scoparius/Sporobolus flexuosus* Shrubland	*Poliomintha incana/Sporobolus flexuosus* Shrubland
GUMO_0181	*Poliomintha incana/Bouteloua breviseta* Gypsophilous Shrubland	*Ephedra torreyana/Bouteloua breviseta* Dwarf-Shrubland
GUMO_0190	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	*Poliomintha incana/Bouteloua breviseta* Gypsophilous Shrubland
GUMO_0191	*Poliomintha incana/Bouteloua breviseta* Gypsophilous Shrubland	NA
GUMO_0194	*Poliomintha incana/Bouteloua breviseta* Gypsophilous Shrubland	NA
GUMO_0195	*Poliomintha incana/Andropogon hallii* Shrubland	NA
GUMO_0196	*Tiquilia hispidissima/Bouteloua breviseta-Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA
GUMO_0202	*Atriplex canescens/Sporobolus nealleyi* Shrubland	NA
GUMO_0208	*Prosopis glandulosa/Sporobolus airoides* Shrubland	NA
GUMO_0214	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Tiquilia hispidissima/Sartwellia flaveriae* Dwarf-Shrubland
GUMO_0215	*Prosopis glandulosa/Sporobolus flexuosus* Shrubland	NA
GUMO_0216	*Larrea tridenta/Sporobolus airoides* Shrubland	NA
GUMO_0219	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0221	*Atriplex canescens/Muhlenbergia porteri-Sartwellia flaveriae* Shrubland	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland
GUMO_0231	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0232	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	NA
GUMO_0233	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Sporobolus airoides* Monotype Herbaceous Vegetation
GUMO_0250	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Atriplex canescens/Sporobolus nealleyi* Shrubland
GUMO_0263	*Larrea tridentata/Krameria grayi* Shrubland	NA
GUMO_0270	*Mortonia scabrella-Parthenium incanum* Shrubland	NA
GUMO_0280	*Fouquieria splendens/Bouteloua eriopoda* Shrub Herbaceous Vegetation	NA
GUMO_0307	*Viguera stenoloba/Bouteloua eriopoda* Shrub Herbaceous Vegetation	NA
GUMO_0314	*Bouteloua eriopoda-Bouteloua gracilis* Herbaceous Vegetation	*Krameria grayi/Dasyochloa pulchella* Dwarf-shrub Herbaceous Vegetation
GUMO_0317	*Acacia neovernicosa/Bouteloua eriopoda* Shrubland	NA
GUMO_0323	*Fouquieria splendens-Tiquilia greggii* Shrubland	*Acacia neovernicosa/Bouteloua eriopoda* Shrubland
GUMO_0336	*Viguiera stenoloba/Parthenium incanum* Shrubland	NA
GUMO_0339	*Fouquieria splendens-Parthenium incanum* Shrubland	NA
GUMO_0341	*Acacia neovernicosa/Agave lechuguilla* Shrubland	NA
GUMO_0346	*Larrea tridentata-Parthenium incanum* Shrubland	NA
GUMO_0348	*Acacia neovernicosa/Bouteloua eriopoda* Shrubland	NA
GUMO_0349	*Parthenium incanum/Bouteloua eriopoda* Dwarf-shrubland	NA
GUMO_0369	*Mimosa biuncifera/Bouteloua curtipendula* Shrubland	*Dasylirion leiophyllum/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation
GUMO_0374	*Mimosa aculeaticarpa* var. *biunciferea/Bouteloua curtipendula* Shrubland	NA
GUMO_0382	*Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_0387	*Agave lechuguilla-Dasylirion leiophyllum/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	NA
GUMO_0412	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland	*Prosopis glandulosa/Sporobulus airoides* Shrubland
GUMO_0421	*Setaria leucophila/Solanum eleagnifolium* Herbaceous Vegetation	*Atriplex canescens/Sporobolus contractus* Shrubland
GUMO_0430	*Prosopis glandulosa/Sporobolus airoides* Shrubland	NA
GUMO_0448	*Prosopis glandulosa/Sporobolus airoides* Shrubland	*Atriplex canescens/Sporobolus airoides/Sartwellia flaveriae* Shrubland
GUMO_0454	*Larrea tridentata*/Sparse Understory Shrubland	NA
GUMO_0460	*Larrea tridentata/Muhlenbergia porteri* Shrubland	NA
GUMO_0465	*Larrea tridentata-Krameria grayi* Shrubland	NA
GUMO_0469	*Larrea tridentata/Muhlenbergia porteri* Shrubland	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0480	*Larrea tridentata-Krameria grayi*i (*erecta*) Shrubland	NA
GUMO_0481	*Larrea tridentata*/Sparse Understory Shrubland	NA
GUMO_0483	*Larrea tridentata*/Sparse Understory Shrubland	NA
GUMO_0484	*Larrea tridentata-Krameria grayi* Shrubland (Possibly)	*Larrea tridentata*-Sparse Understory Shrubland
GUMO_0488a	*Larrea tridentata/Parthenium incanum* Shrubland	NA
GUMO_0488b	*Larrea tridentata-Parthenium incanum* Shrubland	NA
GUMO_0493	*Larrea tridentata/Bouteloua eriopoda* Shrubland	NA
GUMO_0498	*Larrea tridentata*/Sparse Understory Shrubland	NA
GUMO_0500	*Larrea tridentata-Parthenium incanum* Shrubland	NA
GUMO_0535	*Larrea tridentata/Sprorobolus flexuosus* Shrubland	NA
GUMO_0543	*Larrea tridentata/Bouteloua eriopoda* Shrubland	NA
GUMO_0546	*Larrea tridentata-Parthenium incanum* Shrubland	NA
GUMO_0548	*Larrea tridentata*/Sparse Understory Shrubland	NA
GUMO_0552	*Prosopis glandulosa*/Dry Wash Shrubland	NA
GUMO_0555	*Larrea tridentata-Parthenium incanum* Shrubland	*Larrea tridentata-Krameria grayi*i Shrubland
GUMO_0559	*Larrea tridentata/Sprorobolus flexuosus* Shrubland	*Atriplex canescens/Muhlenbergia porteri/Sartwellia flaveriae* Shrubland
GUMO_0561	*Larrea tridentata/Sporobolus flexuosus* Shrubland	NA
GUMO_0567	*Tiquilia hispidissima/Sartwellia flaveriae* Dwarf-Shrubland	*Prosopis glandulosa/Sporobulus airoides* Shrubland or *Yucca elata/Bouteloua eriopoda* Shrub/Herbaceous Vegetation
GUMO_0576	*Larrea tridentata/Sporobolus flexuosus* Shrubland	*Larrea tridentata*/Sparse Understory Shrubland
GUMO_0581	*Bouteloua eriopoda-Muhlenbergia porteri* Herbaceous Vegetation	*Psorothamnus scoparius/Sporobolus flexuosua* Shrubland
GUMO_0583	*Psorothamnus scoparius/Sporobolus flexuosus* Shrubland	*Yucca elata/Bouteloua eriopoda* Shrub Herbaceous Vegetation
GUMO_0584	*Psorothamnus scoparius/Sporobolus flexuosus* (spp.) Shrubland	NA
GUMO_0589	*Prosopis glandulosa/Sporobolus flexuosus* Shrubland	*Psorothamnus scoparius/Sporobolus flexuosus* Shrubland
GUMO_0591	*Prosopis glandulosa* Dry Wash Shrubland	NA
GUMO_0592	*Psorothamnus scoparius/Sporobolus flexuosus* Shrubland	NA
GUMO_0606	*Larrea tridentata/Muhlenbergia porteri* Shrubland	*Viguera stenoloba/Parthenium incanum* Shrubland
GUMO_0610	*Larrea tridentata/Bouteloua eriopoda* Shrubland	*Larrea tridentata/Muhlenbergia porteri* Shrubland
GUMO_0617a	*Larrea tridentata/Muhlenbergia porteri* Shrubland	NA
GUMO_0617b	*Larrea tridentata/Muhlenbergia porteri* Shrubland	*Larrea tridentata/Bouteloua gracilis* Shrubland
GUMO_0620	*Chilopsis linearis-Fallugia paradoxa* Shrubland	*Viguera stenoloba/Parthenium incanum* Shrubland
GUMO_0630	*Viguiera stenoloba/Parthenium incanum* Shrubland	NA
GUMO_0638	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0643	*Fallugia paradoxa/Brickellia laciniata* Shrubland	*Viguiera stenoloba/Parthenium incanum* Shrubland
GUMO_0654	*Larrea tridentata-Parthenium incanum* Shrubland	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0662	*Chilopsis linearis-Fallugia paradoxa* Shrubalnd	*Fallugia paradoxa-Brickellia laciniata* Shrubland
GUMO_0663	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0665	*Larrea tridentata-Muhlenbergia porteri* Shrubland	NA
GUMO_0666	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0668	*Viguera stenoloba-Parthenium incanum* Shrubland	NA
GUMO_0679	*Chilopsis linearis-Fallugia paradoxa* Shrubland	NA
GUMO_0686	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0689	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0698	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0699	*Larrea tridentata-Parthenium incanum* Shrubland	NA
GUMO_0723	*Larrea tridentata/Bouteloua eriopoda* Shrubland	NA
GUMO_0749	*Larrea tridentata-Parthenium incanum* Shrubland	Na
GUMO_0755	*Muhlenbergia setifolia:Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_0761	*Quercus grisea-Arbutus xalapensis* Woodland	NA
GUMO_0762	*Quercus grisea-Arbutus xalapensis* Woodland	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation
GUMO_0764	*Muhlenbergia setifolia:Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_0767	*Quercus grisea-Arbutus xalapensis* Woodland	NA
GUMO_0769	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation
GUMO_0775	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0782	*Quercus* X*pauciloba*, *Q. pungens*, or shrub-saturated *Q. grisea* dominant or codominant with *Cercocarpus montanus*	*Juniperus pinchotii/Quercus* spp./*Muhlenbergia setifolia* shrubland
GUMO_0784	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	Incidental - *Agave parryi* ssp. *neomexicana*, *Damianita (Chrysactinia)*. *Bouteloua gracilis* present and *Aristida* (3-awn), present as minor component.
GUMO_0788	*Fallugia paradoxa* Arroyo Wash Shrubland	NA
GUMO_0851	Unclassified Conifer Forest	*Pseudotsuga menziesii/Muhlenbergia pauciflora* Forest
GUMO_0856	*Pseudotsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_0857	*Pseudotsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_0858	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest
GUMO_0866	*Pseudotsuga menziesii-Quercus gambelii/Piptochaetium fimbriatum (pringlei)* Forest	NA
GUMO_0867	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_0869	*Pinus stobiformis/Festuca arizonica* Forest	NA
GUMO_0872	*Pseudotsuga menziesii-Quercus gambelii/Piptochaetium fimbriatum* Forest	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0875	*Pseutodsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pseutodsuga menziesii-Pinus strobiformis/Muhlenbergia pauciflora* Forest
GUMO_0877	*Pinus stobiformis/Festuca arizonica* Forest	NA
GUMO_0878	*Pseudotsuga menziesii-Pinus strobiformis- Quercus gambelii* Forest	NA
GUMO_0881	*Pseutodsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pseudotsuga menziesii-Quercus gambelii/Piptochaetium fimbriatum* Forest
GUMO_0882	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0883	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pseudotsuga menziesii-Quercus gambelii/Festuca arizonica* Forest
GUMO_0886	*Pinus stobiformis/Festuca arizonica* Forest	NA
GUMO_0888	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0892	*Pseutodsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0893	*Pseudotsuga menziesii-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_0894	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0895	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0896	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_0910	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pseudotsuga menziesii-Quercus gambelii/Piptochaetium fimbriatum* Forest
GUMO_0920	*Pinus strobiformis-Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_0923	*Pseudotsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_0925	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0927	*Pseudotsuga menziesii-Acer grandidentatum-Ostrya knowltonii* Forest	NA
GUMO_0930	*Pseudotsuga menziesii-Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_0938	*Pseudotsuga menziesii-Quercus gambelii/Piptochaetium fimbriatum (pringlei)* Forest	NA
GUMO_0944	*Pseudotsuga menziesii-Ostrya knowltonii* Forest	*Pinus edulis/Muhlenbergia pauciflora* Woodland
GUMO_0945	*Pseudotsuga menziesii-Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_0947	*Pinus strobiformis-Acer grandidentatum-Ostrya knowltonii* Forest (Best Description)	*Pinus strobiformis-Acer grandidentatum-Ostrya knowltonii* Forest (Keyed out to this)
GUMO_0955	*Pinus strobiformis-Acer grandidentatum-Ostrya knowltonii* Forest	*Acer grandidentatum-Quercus muhlenbergia* Forest
GUMO_0969	*Pseudotsuga menziesii-Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_0973	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_0980	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_0986	*Acer grandidentatum-Quercus muhlenbergii* Forest	NA
GUMO_0989	*Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_0996	*Pseudotsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_1006	*Pseudotsuga menziesii-Quercus muhlenbergii/ Piptochaetium pringlei* (not *P. fimbriatum*) Forest	*Pseudtosuga menziesii-Quercus muhlenbergii/Festuca arizonica* Forest
GUMO_1010	*Pinus ponderosa-Quercus gambelii/Piptochaetium fimbriatum (pringlei)* Forest	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest
GUMO_1018	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_1023	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_1029	*Pinus ponderosa/Quercus* X*pauciloba/Muhlenbergia pauciflora* Forest	NA
GUMO_1031	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	NA
GUMO_1034	*Pinus ponderosa-Quercus gambelii/Piptochaetium fimbriatum (pringlei)* Forest	NA
GUMO_1042	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest	*Pinus ponderosa-Quercus gambelii/Piptochaetium pringlei* Forest
GUMO_1043	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_1049	*Pinus ponderosa/Q.* X*pauciloba/Muhlenbergia pauciflora* Forest	NA
GUMO_1056	*Quercus pungens* (*Q.* X*pauciloba*)*/Muhlenbergia pauciflora* Shrubland	*Pseudotsuga menziesii/Muhlenbergia pauciflora* Forest
GUMO_1060	*Pinus edulis/Muhlenbergia setifolia* Woodland	NA
GUMO_1062	*Quercus pungens* (*Q.* X*pauciloba*)*/Muhlenbergia pauciflora* Shrubland	NA
GUMO_1066	*Pinus ponderosa/Q.* X*pauciloba/Muhlenbergia pauciflora* Forest	NA
GUMO_1070	*Pseudotsuga menziesii/Quercus* X*pauciloba / Muhlenbergia pauciflora* Forest	NA
GUMO_1072	*Pseudotsuga menziesii/Quercus* X*pauciloba / Muhlenbergia pauciflora* Forest	NA
GUMO_1076	*Pinus edulis/Muhlenbergia pauciflora* Woodland	NA
GUMO_1079	*Pinus edulis/Muhlenbergia pauciflora* Woodland	*Pinus ponderosa/Quercus* gambelli/*Piptochaetium fimbriatum (pringlei)* Forest
GUMO_1090	*Pinus ponderosa/Q.* X*pauciloba/Muhlenbergia pauciflora* Forest	NA
GUMO_1091	*Pseudotsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_1093	*Pseudotsuga menziesii/Muhlenbergia pauciflora* Forest	NA
GUMO_1104	*Pinus ponderosa/Q.* X*pauciloba/Muhlenbergia pauciflora* Forest	*Pinus edulis/Muhlenbergia setifolia* Woodland
GUMO_1111	Unclassified Conifer Forest	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_1118	*Pinus ponderosa*/*Q.* X*pauciloba*/*Muhlenbergia pauciflora* Forest	NA
GUMO_1119	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	*Pinus edulis*/*Muhlenbergia pauciflora* Woodland
GUMO_1128	*Quercus pungens*/*Muhlenbergia setifolia* Woodland	*Pinus edulis*/*Muhlenbergia setifolia* Woodland
GUMO_1137	*Quercus pungens*/*Muhlenbergia setifolia* Shrubland	*Pinus edulis*/*Muhlenbergia setifolia* Woodland
GUMO_1142	*Pinus ponderosa*/*Q.* X*pauciloba*/*Muhlenbergia pauciflora* Forest	*Pinus edulis*/*Muhlenbergia pauciflora* Woodland
GUMO_1162	*Quercus grisea-Juniperus deppeana*/*Muhlenbergia emersleyi* Woodland	*Acer grandidentatum-Quercus muehlenbergii* Forest
GUMO_1164	*Pinus ponderosa-Acer grandidentatum-Quercus muhlenbergii* Forest	*Acer grandidentatum-Quercus muehlenbergii* Forest
GUMO_1165	*Quercus grisea-Juniperus deppeana*/*Muhlenbergia emersleyi* Woodland	NA
GUMO_1173a	Undetermined	NA
GUMO_1173b	Undetermined	NA
GUMO_1180	*Quercus pungens* (*Q.* X*pauciloba*)/*Muhlenbergia pauciloba* Shrubland	*Pinus ponderosa-Acer grandidentatum-Quercus muhlenbergii* Forest (Before fire)
GUMO_1181	*Acer grandidentatum-Quercus muehlenbergia* Forest	NA
GUMO_1183	*Acer grandidentatum-Quercus gambelii* Forest	NA
GUMO_1193	*Quercus grisea-Juniperus deppeana*/*Muhlenbergia pauciflora* Woodland	NA
GUMO_1208	*Acer grandidentatum-Quercus muhlenbergii* Forest	NA
GUMO_1220	?*Dasylirion leiophyllum*/*Muhlenbergia emersleyi* Foothill Shrubland	NA
GUMO_1223	*Muhlenbergia pauciflora*: *Quercus pungens* (*Q.* X*pauciloba*)/*Muhlenbergia pauciflora* Shrubland	NA
GUMO_1242	*Quercus pungens* (*Q.* X*pauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1246	*Pinus edulis-Juniperus deppeana*/*Piptochaetium fimbriatum* Woodland	*Pinus edulis*/*Muhlenbergia setifolia* Woodland
GUMO_1247	*Quercus pungens* (*Q.* X*pauciloba*)/*Muhlenbergia pauciflora* Shrubland	*Pinus edulis*/*Muhlenbergia pauciflora* Woodland
GUMO_1248	*Pseudotsuga menziesii*/*Muhlenbergia pauciflora* Forest	NA
GUMO_1266a	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	*Juniperus deppeana*/*Q.* X*pauciloba*/*Bouteloua curtipendula* Woodland
GUMO_1266b	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	NA
GUMO_1273	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	NA
GUMO_1275	*Pinus ponderosa*/*Q.* X*pauciloba*/*Muhlenbergia pauciflora* Forest	NA
GUMO_1279	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	NA
GUMO_1285	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	*Pseudotsuga menziesii-Pinus strobiformis-Quercus gambelii* Forest
GUMO_1286	*Pinus edulis*/*Muhlenbergia setifolia* Woodland	NA
GUMO_1292	*Juniperus deppeana-Cercocarpus montanus*/*Muhlenbergia dubia* Shrubland	If call *Pinus ponderosa* dominant = Unclassified Conifer Forest

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_1297	*Hesperostipa neomexicana-Bouteloua curtipendula* Herbaceous Vegetation	*Hesperostipa neomexicana-Dasylirion wheeleri* Herbaceous Vegetation
GUMO_1311	*Pinus edulis/Muhlenbergia pauciflora* Woodland	*Achnatherum lobatum/Bouteloua curtipendula* Herbaceouse Vegetation
GUMO_1313	*Pinus edulis/Muhlenbergia pauciflora* Woodland	NA
GUMO_1325	*Pinus edulis*/(*Juniperus monosperma*)/*Bouteloua gracilis* (*B. hirsuta*) Woodland	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation
GUMO_1352	*Juniperus deppeana/Muhlenbergia pauciflora* Woodland	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation
GUMO_1359	Pinus pondersoa/*Q. Xpauciloba/Muhlenbergia pauciflora* Forest	NA
GUMO_1369	*Quercus Xpauciloba/Muhlenbergia emersleyi* Shrubland	NA
GUMO_1373	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	NA
GUMO_1382	*Pinus edulis/Muhlenbergia pauciflora* Forest	Na
GUMO_1392	*Pinus ponderosa/Quercus Xpauciloba/Muhlenbergia dubia* Forest	*Pinus ponderosa/Quercus Xpauciloba/Muhlenbergia emersleyi* Forest
GUMO_1393	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_1395	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	NA
GUMO_1398	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	*Dasylirion leiophyllum/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation
GUMO_1399	*Quercus grisea-Juniperus deppeana/Piptochaetium fimbriatium* Woodland	*Quercus grisea-Juniperus deppeana/Bouteloua curtipendula* Woodland.
GUMO_1400	*Juniperus deppeana/Bouteloua gracilis* Woodland	*Hesperostipa neomexicana-Bouteloua curtipendula* Herbaceous Vegetation
GUMO_1402	*Quercus grisea/Achnatherum lobatum* Shrubland	NA
GUMO_1403	*Juniperus deppeana/Bouteloua gracilis* Woodland	*Pinus ponderosa-Acer grandidentatum-Quercus muhlenbergii* Forest (Before fire)
GUMO_1405	*Quercus grisea-Juniperus deppeana/Piptochaetium fimbriatum* Woodland	NA
GUMO_1407	*Nolina texana (micrantha)/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	*Quercus grisea-Juniperus deppeana-Muhlenbergia emersleyi* Woodland
GUMO_1410	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	*Dasylirion leiophyllum/Muhlenbergia setifolia* Shrub Herbaceous Vegetation
GUMO_1415	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	*Quercus grisea-Arbutus xalapensis* Woodland
GUMO_1425	*Muhlenbergia emersleyi*: *Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1427	*Muhlenbergia emersleyi*: *Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1428	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	NA
GUMO_1429	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	NA
GUMO_1431	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* Woodland	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_1432	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	*Pinus ponderosa-Acer grandidentatum-Quercus muhlenbergii* Forest (Before fire)
GUMO_1437	*Quercus grisea-Juniperus deppeana/Muhlenbergia pauciflora* Woodland	NA
GUMO_1441	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* (*Bouteloua* spp.) Woodland	NA
GUMO_1442	*Quercus grisea-Arbutus xalapensis* Woodland	*Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland
GUMO_1443	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* Woodland	*Juniperus deppeana/Bouteloua gracilis* Woodland
GUMO_1444	*Quercus* sp./*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1454	*Pinus edulis-Juniperus deppeana*/unknown grasses Woodland	NA
GUMO_1457	NA	NA
GUMO_1469	*Quercus grisea-Arbutus xalapensis* Woodland	NA
GUMO_1489	*Muhlenbergia setifolia:Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_1491	*Quercus grisea-Juniperus deppeana/Muhlenbergia emersleyi* Woodland	*Juniperus deppeana/Bouteloua gracilis* (*hirsuta*) Woodland
GUMO_1495	*Cercocarpus montanus/Muhlenbergia pauciflora* Shrubland	NA
GUMO_1507	*Quercus gambelii/Robinia neomexicana* Shrubland	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest
GUMO_1510	*Robinia neomexicana/Piptochaetium fimbriatum (pringlei)* Shrubland	NA
GUMO_1511	*Quercus gambelii/Robinia neomexicana* Shrubland	*Pinus ponderosa/Quercus* gambelli/*Piptochaetium fimbriatum (pringlei)* Shrubland
GUMO_1518	*Pseutodsuga menziesii-Quercus gambelii/Muhlenbergia pauciflora* Forest	NA
GUMO_1524	*Pinus ponderosa-Quercus gambelii/Festuca arizonica* Forest	NA
GUMO_1538	*Pinus strobiformis/Festuca arizonica* Forest	*Quercus gambelii/Piptochaetium fimbriatum (pringlei)-Festuca arizonica* Woodland
GUMO_1539	*Cercocarpus montanus/Muhlenbergia pauciflora* Shrubland	NA
GUMO_1540	*Pinus ponderosa-Quercus* gamblei/*Piptochaetium pringlei* Forest	NA
GUMO_1565	N/A	N/A
GUMO_1569	*Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_1570	*Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA
GUMO_1586	*Muhlenbergia setifolia*: *Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	*Nolina micrantha (texana?)/Muhlenbergia setifolia* Shrub Herbaceous Vegetation
GUMO_1589	*Mimosa aculeaticarpa* var. *biunciferea/Bouteloua curtipendula* Shrubland	*Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland
GUMO_1591	*Juniperus pinchotii/Quercus pungens/Muhlenbergia setifolia* Woodland	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_1594	*Muhlenbergia setifolia-Bouteloua eriopoda* Herbaceous Vegetation	NA
GUMO_1641	*Achnatherum lobatum-Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1671	*Cercocarpus/Muhlenbergia pauciflora* Shrubland	NA
GUMO_1739	*Muhlenbergia emersleyi*:*Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1782	*Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1787	*Quercus pungens* (*Q. Xpauciloba*)/*Muhlenbergia emersleyi* Shrubland	NA
GUMO_1790	*Quercus grisea/Muhlenbergia emersleyi* Shrubland	NA
GUMO_1806	*Achnatherum lobatum-Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1813	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1818	*Dasylirion leiophyllum/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	NA
GUMO_1835	*Nolina texana/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	*Achnatherum lobatum/Bouteloua curtipendula* Herbaceouse Vegetation
GUMO_1841	*Dasylirion leiophyllum/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	NA
GUMO_1846	*Bouteloua gracilis* (*hirsuta*)/P*anicum obtusum* Herbaceous Vegetation	*Nassella tenuissima-Bouteloua gracilis* (*hirsuta*) Herbaceous Vegetation
GUMO_1851	*Bouteloua gracilis* (*bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	Na
GUMO_1852	*Bouteloua gracilis*-P*anicum obtusum* Herbaceous Vegetation	*Nassella tenuissima-Bouteloua gracilis* Herbaceous Vegetation
GUMO_1853	*Viguera stenoloba/Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_1857	*Nassella tenuissima-Bouteloua gracilis* (*hirsuta*) Herbaceous	NA
GUMO_1865	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1868	*Bouteloua gracilis-Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1869	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1890	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1891	*Bouteloua gracilis* (*Bouteloua hirsuta*)-*Bouteloua curtipendula* Herbaceous Vegetation	Na
GUMO_1895	*Bouteloua gracilis/Bouteloua curtipendula* Herbaceous Vegetation	NA
GUMO_1906	*Nolina texana/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	NA
GUMO_1908	*Muhlenbergia setifolia/Bouteloua* sp. Herbaceous Vegetation	NA

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_1910	*Cercocarpus montanus*/*Muhlenbergia setifolia* Shrubland	*Juniperus pinchotii*/*Quercus pungens* (*grisea*) / *Muhlenbergia setifolia* Woodland
GUMO_1915	*Bouteloua* sp. Herbaceous Vegetation	NA
GUMO_1919	*Mimosa aculeaticarpa* var. *biuncifera*/*Bouteloua curtipendula* Shrubland	NA
GUMO_1920	*Aristida* sp.	NA
GUMO_1921	*Mimosa aculeaticarpa* var. *biuncifera*/*Bouteloua curtipendula* Shrubland	*Viguera stenoloba*/*Parthenium incanum* Shrubland
GUMO_1922	*Cercocarpus montanus*/*Muhlenbergia setifolia* (*Muhlenbergia metcalfii*) Shrubland	NA
GUMO_1923	*Nolina texana*/*Muhlenbergia setifolia* Herbaceous Vegetation	NA
GUMO_1929	*Viguera stenoloba*/*Parthenium incanum* Shrubland	*Muhlenbergia setifolia* (*Muhlenbergia metcalfii*)-*Bouteloua eriopoda* Herbaceous Vegetation
GUMO_1939	*Mimosa aculeaticarpa* var. *biuncifera*/*Bouteloua curtipendula* Shrubland	NA
GUMO_1941	*Viguiera stenoloba*/*Parthenium incanum* Shrubland	*Muhlenbergia setifolia* (*Muhlenbergia metcalfii*)-*Bouteloua eriopoda* Herbaceous Vegetation
GUMO_1942	*Viguiera stenoloba*/*Parthenium incanum* Shrubland	*Muhlenbergia setifolia* (*Muhlenbergia metcalfii*)-*Bouteloua eriopoda* Herbaceous Vegetation
GUMO_1949	*Bouteloua gracilis*-P*anicum obtusum* Herbaceous Vegetation	*Bouteloua gracilis*/Ruderal Herbaceous Vegetation
GUMO_1952	*Muhlenbergia setifolia-Bouteloua eriopoda* Herbaceous Vegetation	NA
GUMO_1954	*Yucca elata*/*Bouteloua eriopoda-Bouteloua gracilis* Shrub Herbaceous Vegetation	NA
GUMO_1963	*Bouteloua eriopoda-Bouteloua gracilis* Herbaceous Vegetation	*Parthenium incanum*/*Bouteloua eriopoda* Dwarf-shrubland
GUMO_1970	*Juniperus pinchotii*/*Quercus pungens* (*Q.* X*pauciloba*) / *Muhlenbergia setifolia* Woodland	NA
GUMO_1977	*Bouteloua eriopoda-Hesperostipa neomexicana* Herbaceous Vegetation	NA
GUMO_1982	*Yucca elata*/*Bouteloua eriopoda-Bouteloua gracilis* Shrub Herbaceous Vegetation	NA
GUMO_1988	*Bouteloua eriopoda-Bouteloua gracilis* Herbaceous Vegetation	*Bouteloua eriopoda-Bouteloua curtipendula* Herbaceous vegetation
GUMO_1992	*Aristida* sp.	NA
GUMO_1993	*Yucca elata*/*Bouteloua eriopoda-Bouteloua gracilis* Shrub Herbaceous Vegetation	NA
GUMO_2010	*Viguiera stenoloba*/*Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_2017	*Dasylirion leiophyllum*/*Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_2019	*Cercocarpus montanus*/*Muhlenbergia setifolia* Shrubland	*Nolina texana*/*Muhlenbergia setifolia* Shrub Herbaceous Vegetation
GUMO_2022	*Viguiera stenoloba*/*Parthenium incanum* Shrubland	Also present - *Rhus trilobata* (less than 0.5m tall) and a little broomweed.
GUMO_2035	*Viguera stenoloba*/*Parthenium incanum* Shrubland	*Cercocarpus montanus*/*Muhlenbergia setifolia* Shrubland

Table E4 (continued). AA plot/target points with plant association identified using keys to Guadalupe Mountains National Park plant association (Muldavin 2013).

AA IRS Plot No.	AA Primary Association	AA Secondary Association
GUMO_2037	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_2040	*Dasylirion leiophyllum/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	NA
GUMO_2045	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation
GUMO_2049	*Larrea tridentata/Bouteloua eriopoda* Shrubland	*Fouquieria splendens/Parthenium incanum* Shrubland
GUMO_2055	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_2071	*Nolina texana/Muhlenbergia setifolia* Shrub Herbaceous Vegetation	*Hesperostipa neomexicana/Dasylirion wheeleri* Shrub Herbaceous Vegetation
GUMO_2074	*Dasylirion leiophyllum/Bouteloua curtipendula* Shrub Herbaceous Vegetation	NA
GUMO_2077	*Quercus Xpauciloba/Cercocarpus* Shrubland	
GUMO_2079	*Mortonia scabrella - Parthenium incanum* Shrubland	NA
GUMO_2085	*Hesperostipa neomexicana-Dasylirion wheeleri* Herbaceous Vegetation	Hesterostipa *neomexicana-Bouteloua curtipendula* Herbaceous Vegetation
GUMO_2086	*Nolina texana/Muhlenbergia emersleyi* Shrub Herbaceous Vegetation	NA
GUMO_2170	*Nolina texana/Bouteloua eriopoda* Shrub Herbaceous Vegetation	NA
GUMO_2176	*Larrea tridentata/Bouteloua eriopoda* Shrubland	NA
GUMO_2190	*Larrea tridentata-Krameria grayi*i Shrubland	*Viguiera stenoloba/Parthenium incanum* Shrubland
GUMO_9000-NEW	*Juniperus deppeana/Bouteloua gracilis* Woodland	NA
GUMO_9901-NEW	*Tiquilia hispidissima/Sporobolus nealleyi* Shrub Herbaceous Vegetation	NA

Supplement 4. Examples of field maps used in GUMO AA survey

Figures E7–E10 show examples of field maps used the Guadalupe Mountain NP AA survey.

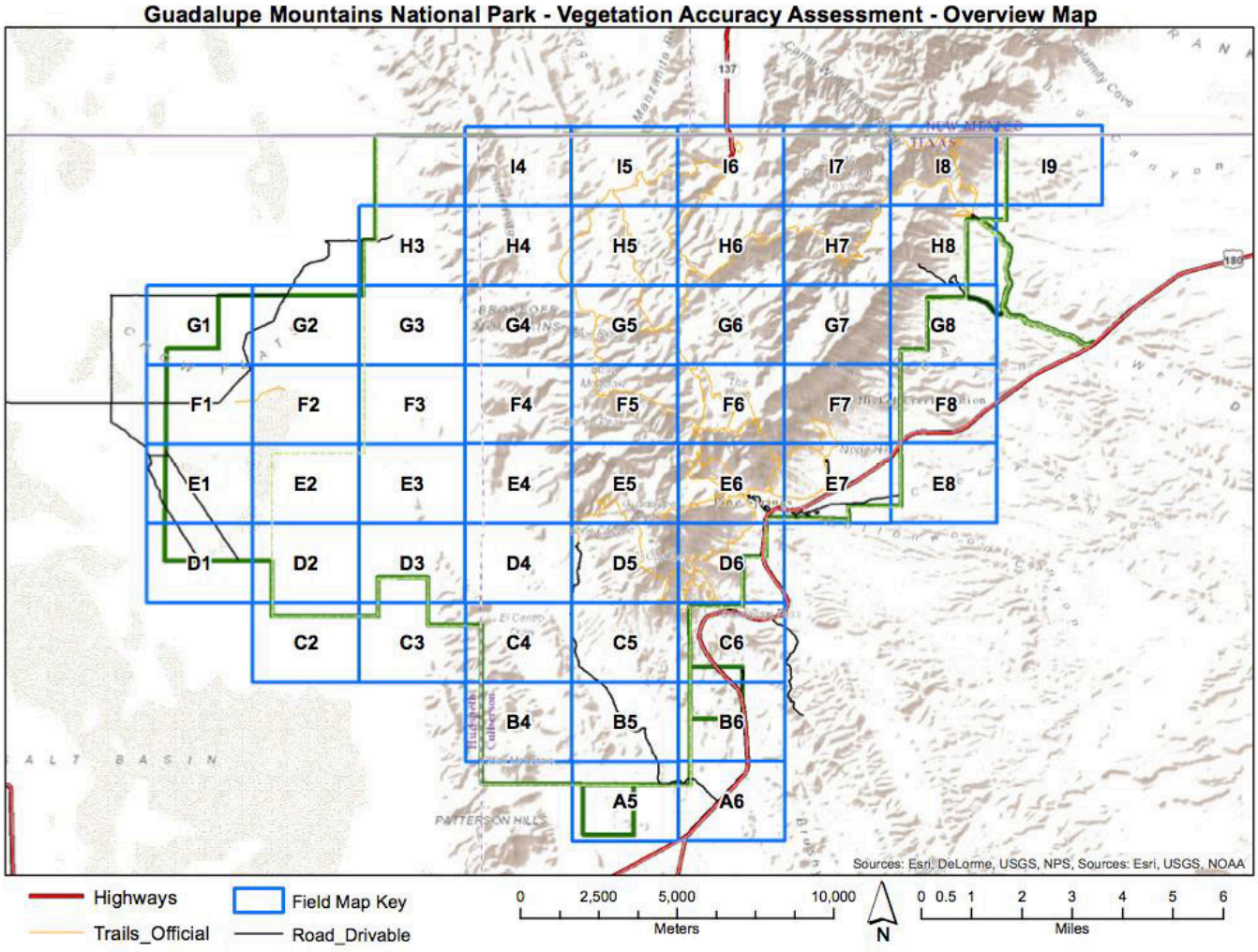
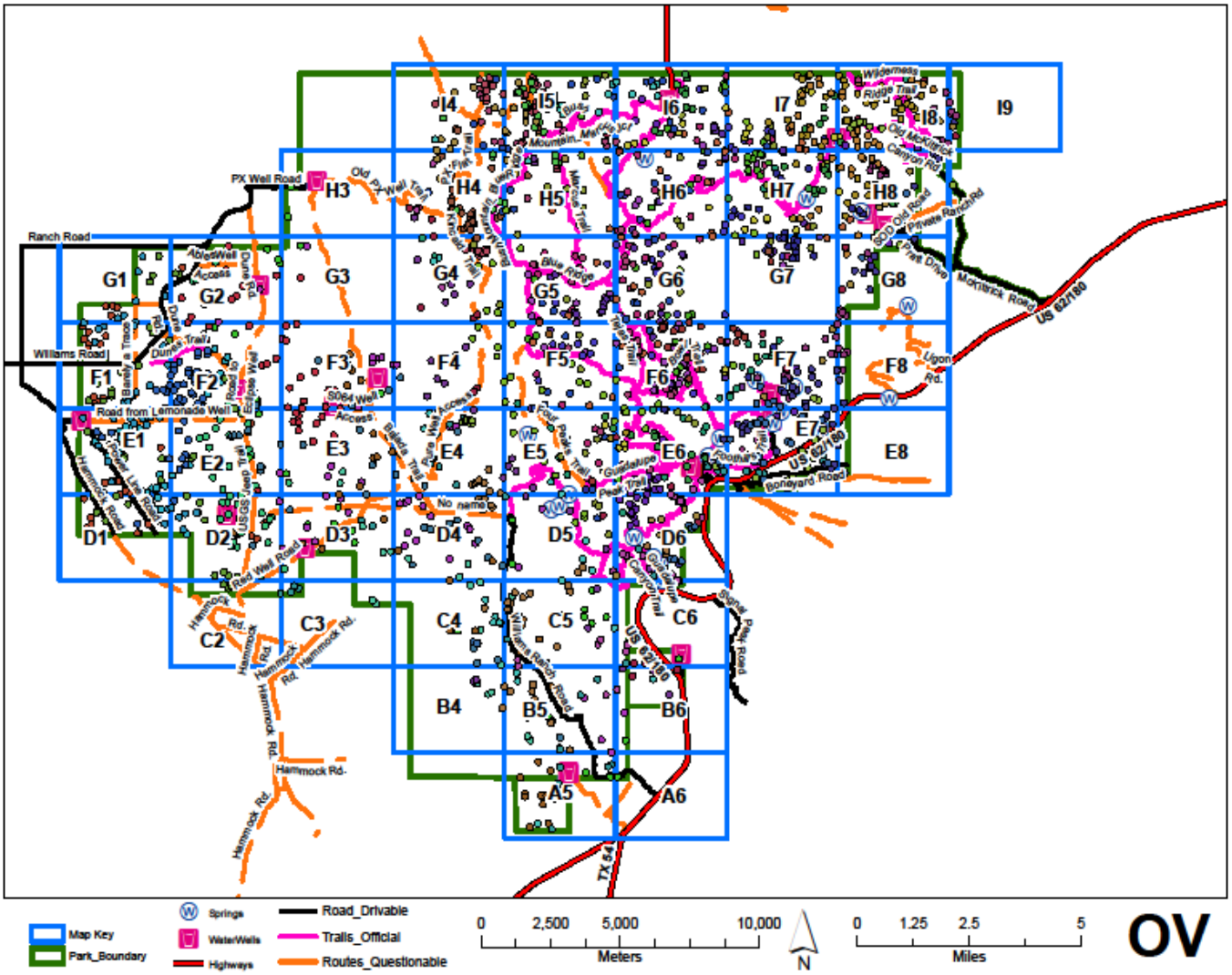


Figure E7. Map 1 - Overview field map with map grids overlain.


Ranch Road
Williams Road
PX Well Road
Old PX Well Trail
Road from Lemonade Well
Hammock Rd.
Hammock Rd
Hammock Rd.
Hammock Rd.
Hammock Rd.
Hammock Rd.
Williams Ranch Road
Bonevard Road
Stone Peak Road
Old McKittrick Canyon Rd
McKittrick Road
US 62/180
Ligon Rd.
Wilderness Ridge Trail
Blue Ridge
Marcus Trail
Pine Top Trail
Guadalupe Peak Trail
Tejas Trail
Bush Mountain
Meadow Jct
Dog Canyon
Private Ranch Rd
Dog Canyon Road
Four Peaks Trail
Bush Mountain Trail
Devil's Hall Trail
Dunes Trail
Dunes Trail
Abbott Well Access
Abbott Well Access
Eclipse Well Road
Eclipse Well Trail
Bluestem Trail
Pure Well Access
Pure Well Road
Hammock Road
Hammock Jeep Trail
Hammock Line Road
Hammock Jeep Trail
Old Well Road
Old Well Road
Old Well Trail
Old Well Trail
Old Well Trail

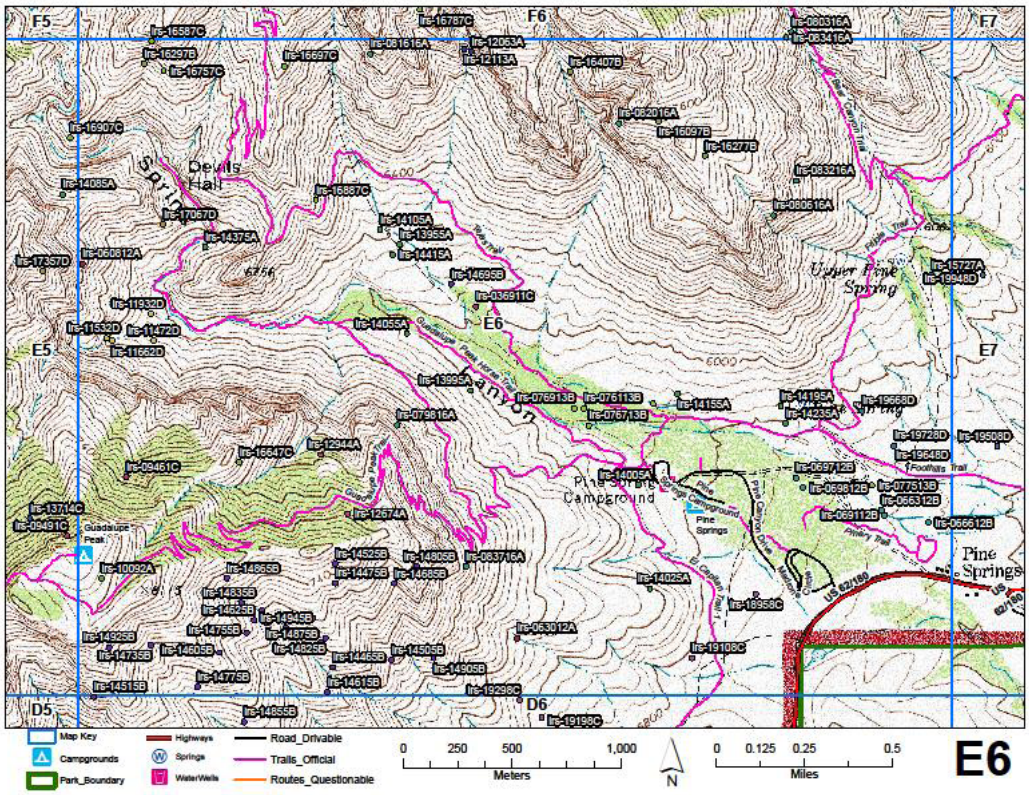


Figure E9. Map 3 – Example of a USGS 7.5 minute topographic field map with AA/IRS plot target points.

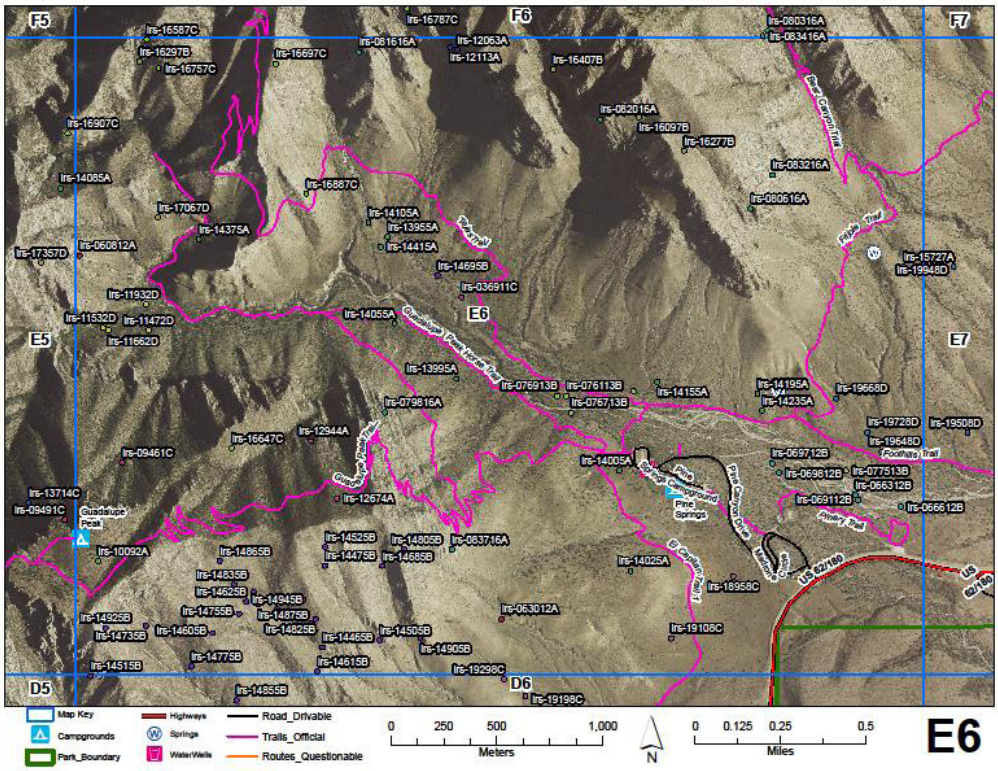


Figure E10. Map 4 – Example of an orthographic imagery field map with AA/IRS plot target points.

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National Park Service
U.S. Department of the Interior

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