Another Jewel in the Crown: A Report on the Flora of the Sierra De Los Ajos, Sonora, Mexico

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Abstract. —We report here on the flora of the Sierra de los Ajos, Sonora, Mexico, based on collections made in 1992 and 1993. The known flora of this Sky Island range contains 376 species of vascular plants in 93 families. Based on our collections and the results of floristic studies of other Sky Island ranges, we anticipate that the total flora of the Sierra de los Ajos contains over 1000 species. We have documented the only known occurrences in Mexico of two species that are candidates for listing as threatened or endangered species in the United States, various new distribution records for Mexico and Sonora, and large range extensions of a number of other plants. This work contributes to a projected flora of the Sky Island region.

INTRODUCTION

The flora of the Sierra de los Ajos includes several notable taxa, including some that are considered in danger of extinction, some that are far disjunct from the nearest known populations, and some that show a marked extension of their known range. We have documented several state and national distribution records in the Ajos. We predict that the total flora of the range will exceed 1000 species, and will contain a highly diverse mixture of biogeographic elements, as is typical of regional Sky Island ranges. Because they occur near the center of the Sky Island bioregion, which includes isolated mountain ranges south of the Mogollon Rim and north of the Sierra Madre Occidental, the flora of the Sierra de los Ajos provides an important basis for understanding the flora of the bioregion as a whole.

The Sierra de los Ajos occur in a botanically underexplored region of North America. Despite over 70 years of intensive collecting, the Sky Island bioregion remains one of the least well known floristic areas of temperate North America. The paucity of floristic information about the Sky Islands north of the Mexico-U.S. border is surprising considering that the floras of New Mexico and Arizona were first produced in the early part of this century (Wooton and Standley 1915, Kearney and Peebles 1942). In fact, many of the additions to the flora of Arizona have come from botanical exploration of the Sky Islands (e.g. Lehr and Pinkava 1980, 1982). It is perhaps less surprising that the ranges that lie to the south of the international border have received comparatively less attention, because of their location on the northwestern frontier of Mexico. To date, reasonably complete floras have been published for only three of the aproximately two dozen Sky Island ranges: the Sierra del Tigre in Sonora (White 1948) and the Rincon Mountains (Bowers and McLaughlin 1987) and Pinaleno Mountains (McLaughlin 1993) in Arizona. The flora of the Huachuca Moutains in Arizona is in preparation and will soon be submitted for publication (J. Bowers and S. McLaughlin, *personal communication*).

The Sierra de los Ajos lie just south of the international border, which nearly bisects the region (fig. 1). Like the Sky Island region generally, the Ajos occur at the juncture of four major biogeographic regions: Madrean, Sonoran, Chihuahuan, and Southern Rockies/Mogollon, in approximate order of their contribution to the flora. Streams rising in the Ajos contribute to three major river systems: the northward-flowing Río San Pedro and the southward-flowing Río Sonora

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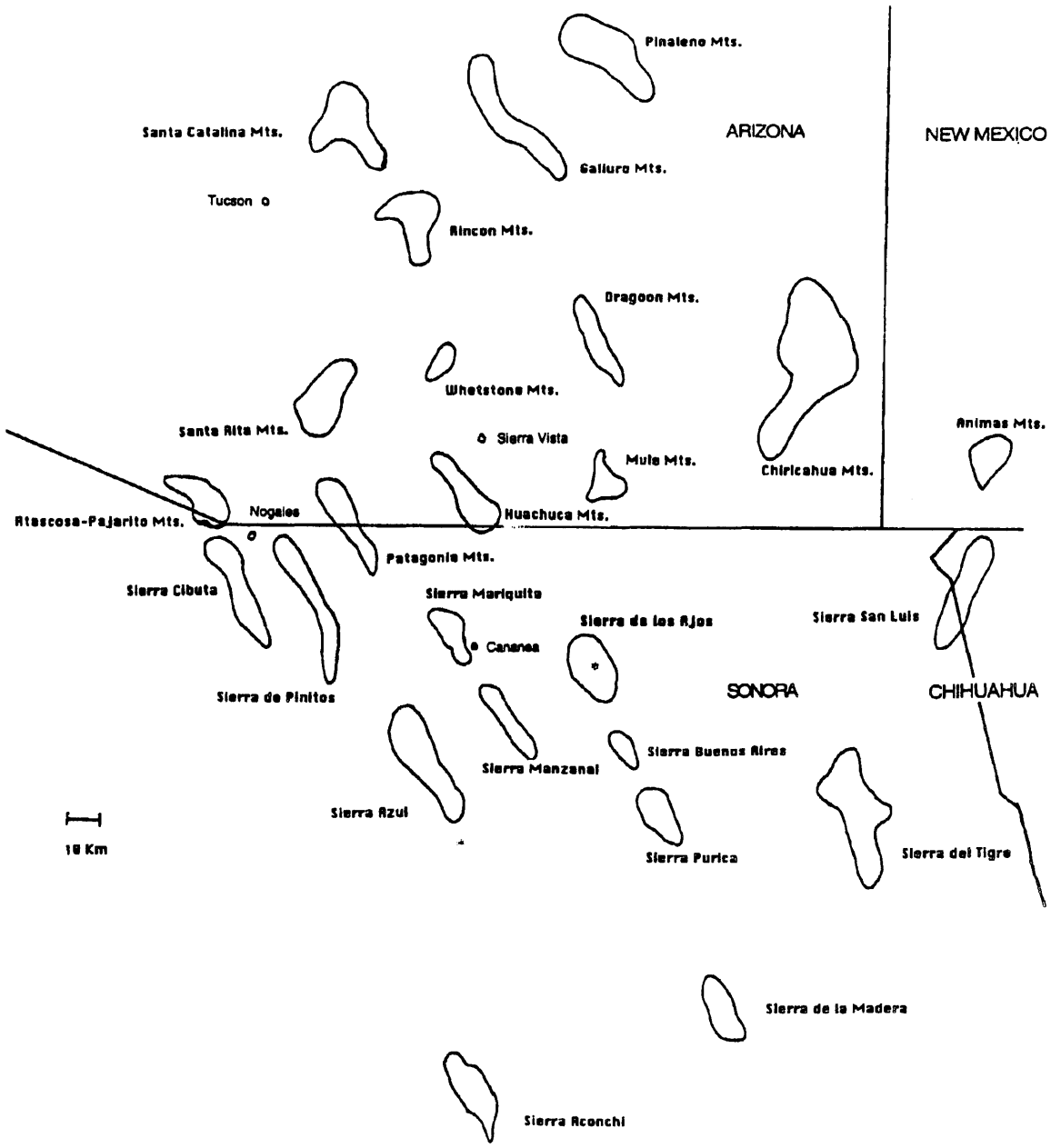

Figure 1.—The Sky Island bioregion of northwestern Mexico and southwestern United States. Sierra de los Ajos are indicated by an asterisk (*).

and Río Yaqui. Although several streams have perennial stretches, none have perennial flows beyond the pediment of the range or reach the major rivers of the valleys.

The low point in the valleys surrounding the Ajos occurs at Bacoachi on the Río Sonora (~1050 m). The highest peak, Cerro de las Flores, rises to 2625 m and is the highest point in the state of Sonora. Thus, the overall relief in the Ajos is approximately 1575 m. This elevational range lies between that of the Huachuca Mts. (~1375 m) and the Rincon Mts. (~1725 m) and is an intermediate value for the Sky Islands.

The prevalent geological formations in the Sierra de los Ajos are volcanic and of Tertiary origin. An unusual feature of the range, and one that is presumably important to the flora and vegetation, is the large outcrop of limestone (probably of Cretaceous origin) that forms the three highest peaks of the range. Following the

formation of these rocks, basin and range faulting and subsequent erosion created the present-day topography of these mountains.

The climate of the Ajos is typical of the region, with bimodal, nearly equally distibuted summer and winter rainfall, interrupted by a hot arid foresummer (Solis-Garza, et al. 1993). Near desert conditions prevail at the lowest elevations, whereas the highest peaks experience a much cooler and wetter climate due to orthographic processes. Microclimate diversity also contributes to the floristic diversity Southern exposures that are protected from frost can support species with "tropical" affinities, whereas steep north-facing canyons with cold air drainage support species with northern affinities.

VEGETATION

Biotic communities in the Sierra de los Ajos include mixed conifer forest, montane meadows, "montane chaparral", pine-oak forest, oak woodland, oak and mesquite grassland, and riparian forest. Only a brief discussion of these communities, which have been discussed in detail elsewhere (e.g. Marshall 1957, Brown 1982), will be presented here.

Mixed conifer forest is of limited extent in the Ajos and is restricted to north-facing slopes at high elevation. Common trees include *Abies concolor, Pinus ponderosa* var. *arizonica, Pinus strobiformis,* and *Pseudotsuga menziesii*. Montane meadows occur at sites that would support mixed conifer, pine, or pine-oak forest in the absence of fire. Because of the fire history of the Ajos (see below), these areas now support a diverse assemblage of herbs and grasses including *Blepharoneuron tricholepis, Delphinium tenuisectum, Glandularia bipinnatifida, Koehleria macrantha, Salvia lemmoni, Silene laciniata,* and *Viguiera multiflora*. "Montane chaparral" occurs at high elevations on exposed limestone ridges, including the tops of the highest peaks. Common species in this association include *Cercocarpus brevifolius, Eriogonum jamesii, Holodiscus dumosus,* and *Quercus gambelii*.

Pine-oak forest is the most wide spread forest type in the Ajos and is predominant at mid-elevations. Common trees and shrubs include *Arbutus arizonica, Arctostaphylos pungens, Ceanothus depressus, Garrya wrightii, Juniperus deppeana, Pinus engelmannii, P. ponderosa* var. *arizonica, Quercus arizonica, Q. emoryi, Q. hypoleucoides,* and *Rhus trilobata*. Oak woodland and grassland occur on north-facing slopes at the lowest elevations and on south-facing slopes from low- to mid-elevations. The common oaks are *Quercus emoryi, Q. oblongifolia,* and *Q. arizonica*. Common grasses include *Bouteloua* spp., *Eragrostis* spp., *Bothriochloa barbinodis,* and *Aristida* spp. Other conspicuous species include *Juniperus deppeana,* and *Agave* cf. *palmeri*. Some level sites in this elevational range are dominated by *Juniperus coahuilensis* and *Yucca arizonica*.

Riparian forests change more gradually with elevation than the corrsponding ridge and slope vegetation. At low elevations xeroriparian areas support a sparse woodland of *Celtis reticulata, Chilopsis linearis,* and *Prosopis velutina*. At the foot of the range, *Populus fremontii, Platanus wrightii* and *Fraxinus velutina* form streamway forests. At mid-elevations in Cañón Evans, a diverse riparian assemblage includes *Acer grandidentatum, Alnus oblongifolia, Juglans major, Juniperus scopulorum,* and *Populus fremontii. Abies concolor, Acer grandidentatum,* and *Populus tremuloides* occur at the heads of the major canyons. Riparian communities along one stream in the Ajos are described by Solis-Garza and associates (1993).

FLORA

The earliest botanical collections from the Sierra de los Ajos preserved in herbaria are likely to be those of George Thurber, botanist with the first U.S.-Mexico Boundary Commission. The commission approached the Ajos from the east and skirted the eastern and southern flanks of the range in May and June of 1851 on their way to Bacoachi, on the Río Sonora (Bartlett 1854).

The first collections from this century that we have seen were made by Joe Marshall in 1951. Marshall collected extensively in Cañón Evans, a very large, north and west trending canyon that contains the largest perennial stream in the range. Marshall was the first to document a distinct Madrean pine-oak forest that extends north through the Sky Islands in his classic publication on birds of the pine-oak woodland (Marshall 1957).

We are aware of four collections from the Sierra de los Ajos from the 1980's and early 1990's. In September 1982, Frank Reichenbacher made an extensive collection in Cañón Evans. Paul Martin and associates made small collections in July 1983 and April 1991, also in Cañón Evans. Peter Warren and Esther Saucedo surveyed this canyon for rare plants in 1989. Prior to our efforts, most collecting in the range has occurred in Cañón Evans.

Thus far we have made two extensive collecting trips in the Sierra de los Ajos totaling ten person-days of fieldwork. In October 1992 we surveyed the grassland on the north side of the range, the lower reaches of Cañón Evans, a transect leading up the north side of the range (along an old roadway), the heads of the major east- and west-trending streams (Arroyo Frijolito and Hoya del Packard, respectively), the saddle between the highest peaks of the range, and the north slope and top of the highest peak (Cerro de las Flores). In July 1993 we surveyed in the southern portion of the range, mostly in the vicinity of Arroyo La Cieneguita and the southern crest of the range, as well as the pass between the Ajos and the Sierra Buenos Aires. Our collections are thus biased towards the summer flora and we expect that further additions to the flora will contain many cool-season ephemeral and spring-flowering perennial species.

To date we have documented 376 species of vascular plants in 246 genera and 93 families (Appendix 1). Our records are based primarily on our collections, the first set of which is deposited at the University of Arizona Herbarium (ARIZ); a second set is deposited at the herbarium at the Instituto de Biología, UNAM (MEXU), and additional duplicates are deposited elsewhere. Some records are based on other collections at ARIZ, on our photo vouchers, and on undocumented observations. The five families that contribute the most to the known flora are Asteraceae (62 species), Poaceae (49), Fabaceae (33), Lamiaceae (9), and Scrophulariaceae (9). These families account for 43% of the specific and intraspecific taxa in the known flora. The nine largest genera in the flora are *Muhlenbergia* (Poaceae, 9 species), *Asclepias* (Asclepiadaceae, 8), *Quercus* (Fagaceae, 8), *Aristida* (Poaceae, 5), *Bouteloua* (Poaceae, 5), *Brickellia* (Asteraceae, 5), *Erigeron* (Asteraceae, 5), *Pinus* (Pinaceae, 5), and *Senecio* (Asteraceae, 5).

One of the significant results of our surveys is the documentation of previously unknown populations of species being considered for listing as endangered or threatened in the United States, new records for Mexico and Sonora, and extensions of the known ranges of various species (Table 1). We located new populations of *Lilium parryi* (Liliaceae) and *Rumex orthoneurus* (Polygonaceae), both Category 1 candidates for listing as federally endangered or threatened species by the United States Fish and Wildlife Service, and both previously unknown in Mexico (Felger and Fishbein 1993, Fishbein and Felger 1993). Two of the more surprising collections from the Ajos are the southwest extension of the range of *Arenaria stricta* ssp. texana from west Texas and the northwest extension of Tinantia erecta from southwestern Chihuahua.

Table 1.—Notable Collections in the Sierra de los Ajos.

Species (Family)	Significance
Antennaria marginata (Asteraceae)	New record for Sonora
Arenaria stricta (Caryophyllaceae)	New record for Sonora, new record for Sky Islands, range extension from western Texas
Asclepias nyctaginifolia (Asclepiadaceae)	New record for Sonora
Botrychium virginianum (Ophioglossaceae)	Only extant Sky Island population (see text)
Cheilanthes eatonii (Adiantaceae)	New record for Sonora?
Desmanthus cooleyi (Fabaceae)	New record for Sonora
Euphorbia melanadenia (Euphorbiaceae)	New record for Sonora
Galium pilosum (Rubiaceae)	New record for Mexico, range extension from Pinaleño Mts.
Lilium parryi (Liliaceae)	New record for Mexico
Rumex orthoneurus (Polygonaceae)	New record for Mexico
Smilacina racemosa (Convallariaceae)	New record for Mexico?
Smilacina stellata (Convallariaceae)	New record for Mexico?
Thermopsis montana (Fabaceae)	New record for Mexico?
Tinantia erecta (Commelinaceae)	New record for Sonora, new record for Sky Islands, range extension from southwestern Chihuahua
Trifolium wormskioldii (Fabaceae)	New record for Mexico?

In a sense, the Sierra de los Ajos and Huachuca Mountains can be thought of as "sister ranges" because of their close proximity and similar geology and elevational range. Because the Huachucas have a well-documented flora (J. Bowers and S. McLaughlin, in preparation), it is interesting to note which taxa occur in the Ajos but not in the Huachucas. We have documented 20 such taxa (Table 2). Most of these taxa are Madrean species that reach their northern limit in the Sierra de los Ajos (e.g. Ratibida mexicana, Quercus mcvaughii, Q. viminea, Tinantia erecta). Some, however, are species apparently restricted to very mesic or high elevation habitats (i.e. Alnus oblongifolia, Botrychium virëa maculata, Galérorum, and Thermopsis moning that these pæual populationse Ajos, but not tsidering that the Huachucas occur further north and rise to an elevation 270 m higher than the Ajos. Botrychium virginianum was known elsewhere in the region only from the Santa Rita Mountains, where it has not been seen for about 100 years and is presumed extirpated. Galium pilosum is otherwise known in the region only from two collections from the Pinaleño Mountains. Juniperus scopulorum is unknown elsewhere in the region.

The proportion of non-native species in the flora is remarkly low (14 species, or 3.7% of the total flora). This low figure may reflect sampling bias (e.g. if the spring flora has disproportionately more non-natives) or an actual deficit of introduced species. If this pattern is supported by further collections, it certainly merits future investigations into the cause of the resistance of the Sierra de los Ajos to non-native plant invasions.

McLaughlin's (1993) analysis of the relationship of elevational range and native species richness in the southwestern United States would predict about 600 species for the Sierra de los Ajos, based on elevational range alone. Although the known flora of the Pinaleño Mountains is well-predicted by this relationship, other Sky Islands (i.e. the Rincon Mountains and the Huachuca Mountains) greatly exceed their predicted values, by 50% in the case of the Rincons and 90% in the case of the Huachucas. Based on these values, the flora of the Ajos should contain 900-1100 species.

HUMAN INFLUENCES AND FUTURE PROSPECTS

A major factor influencing the vegetation of the Sierra de los Ajos has been frequent fires. Especially in the last century, fires have dramatically altered the appearance and composition of vegetation (M. Fishbein, personal observation; Swetnam 1988). This is particulary evident in the high country, which is covered by meadows and "chaparral" rather than forest. Compared to similar ranges in the United States, there is a relative lacknce in the formùo los Ajos. The Ajos have been cited as an example of an area that has experienced natural fire regimes in the period since European colonization (Swetnam 1988). The Huachuca Mountains, which have arguably experienced more catastrophic fires in the last two decades because of a history of fire suppression, make an interesting comparison to the Sierra de los Ajos. Such a comparison would be a valuable first step in generating hypotheses about the effects of burn suppression on floras.

Table 2.—Native vascular plant taxa known from the Sierra de los Ajos that are unknown from the Huachuca Mountains.

Species (Family)
Agastache pallida (Lamiaceae)
Alnus oblongifolia (Betulaceae)
Arenaria stricta (Caryophyllaceae)
Botrychium virginianum (Ophioglossaceae)
Chimaphila maculata (Ericaceae)
Conopholis alpina (Orobanchaceae)
Galium pilosum (Rubiaceae)
Gutierrezia alamanii (Asteraceae)
Hoffmanseggia glauca (Fabaceae)
Juniperus scopulorum (Cupressaceae)
Lopezia gracilis (Onagraceae)
Penstemon campanulatus (Scrophulariaceae)
Phlox nana (Polemoniaceae)
Quercus mcvaughii (Fagaceae)
Quercus viminea (Fagaceae)
Ratibida mexicana (Asteraceae)
Seymeria bipinnatisecta (Scrophulariaceae)
Thermopsis montana (Fabaceae)
Tinantia erecta (Commelinaceae)
Yucca arizonica (Agavaceae)

Mining seems to have been of limited scope in the Sierra de los Ajos. Although there are no currently active mines, the geology of the range and the proximity to the large mines at Cananea suggest potential mineral exploitation in the future.

Current human uses of the Sierra de los Ajos center on cattle ranching. The lower elevations are readily accessible to cattle and are utilized as rangelands. The steepest high-elevation canyons and some lower elevation cliffs are inaccessible to livestock. In 1993, some riparian areas on the south side of the range showed evidence of the cumulative impacts of intensive grazing. Overgrazed clumps of grass were very sparse and large stands of weedy native (e.g. *Croton texensis*) and non-native (e.g. *Nicotiana glauca*) species formed dense and extensive patches.

The Sierra de los Ajos has been included in a system of state level ecological preserves in the SANPES program. Although it was formerly managed by the federal forestry agency (SARH), management of many preserves in the SANPES program are administered by the Centro Ecologico de Sonora. The Ajos were originally included among these, but their mangement has now reverted to SARH.

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Appendix 1. Checklist of the Flora of the Sierra de los Ajos, Sonora, Mexico. Records are based primarily on specimens collected by the authors and associates, 1992-1993. A few records are based on other collections, photo vouchers, or observations. Non-native and apparently self-reproducing species are indicated by an asterisk (*).

Acanthaceae
Dyschoriste decumbens (A. Gray) Kuntz

Aceraceae
Acer grandidentatum Nuttall

Adiantaceae
Argyrochosma limitanea (Maxon) Windham var. *mexicana* (Maxon) Windham
Bommeria hispida (Kuhn) Underwood
Cheilanthes bonariensis (Willdenow) Proctor
Cheilanthes eatoni Baker
Cheilanthes wrightii Hooker
Pellaea atropurpurea (L.) Link

Agavaceae
Agave cf. *palmeri* Englemann
Agave parryi Engelmann var. *huachucensis* (Baker) Little *ex* L.D. Benson
Yucca arizonica McKelvey
Yucca schottii Engelmann

Alliaceae
Allium plummerae S. Watson

Amaranthaceae
Alternanthera repens (L.) Kuntze ?
Amaranthus graecizans L.
Amaranthus cf. *palmeri* S. Watson

Anacardiaceae
Rhus trilobata Nuttall
Rhus choriophylla Wooton & Standley
Rhus glabra L.
Toxicodendron radicans Kuntze var. *divaricatum* (Greene) Barkley

Apiaceae
Eryngium heterophyllum Engelmann
Eryngium lemmoni Coulter & Rose
Ligusticum porteri Coulter & Rose
Pseudocymopterus montanus (A. Gray) Coulter & Rose

Apocynaceae
Macrosiphonia brachysiphon (Torrey) A. Gray

Araliaceae
Aralia racemosa L.

Asclepiadaceae
Asclepias asperula (Decaisne) Woodson ssp. *asperula*
Asclepias elata Bentham
Asclepias hypoleuca (A. Gray) Woodson
Asclepias lemmoni A. Gray
Asclepias nummularia Torrey
Asclepias nyctaginifolia A. Gray
Asclepias subverticillata (A. Gray) Vail
Asclepias tuberosa L. ssp. *interior* Woodson

Aspleniaceae
Asplenium resiliens Kunze

Asteraceae
Ageratina herbacea (A. Gray) King & Robinson
Ageratina rothrockii (A. Gray) King & Robinson
Ambrosia psilostachya DC.
Antennaria marginata Greene
Artemesia dracunculus L.
Artemesia ludoviciana Nuttall var. *mexicana* (Willdenow *ex* Sprengel) Fernald
Aster potosinus A. Gray
Baccharis salicifolia (Ruiz & Pavón) Persoon
Baccharis thesioides H.B.K.
Baccharis cf. *pteronioides* DC.
Bahia dissecta (A. Gray) Britton
Bidens aurea (Aiton) Sherff
Bidens bigelovii A. Gray
Brickellia betonicaefolia A. Gray
Brickellia eupatorioides (L.) Shinners var. *chlorolepis* (Wooton & Standley) B. Turner
Brickellia grandiflora (Hooker) Nuttall
Brickellia rusbyi A. Gray
Brickellia simplex A. Gray
Centaurea rothrockii Greenman
Cirsium sp. 1
Cirsium sp. 2
Conyza canadensis (L.) Cronquist
Cosmos parviflorus (Jacquin) H.B.K.
Erigeron arisolius Nesom
Erigeron arizonicus A. Gray
Erigeron cf. *flagellaris* A. Gray
Erigeron neomexicanus A. Gray
Erigeron platyphyllus Greene
Galinsoga parviflora Cavanilles
Gnaphalium macounii Greene
Guardiola platyphylla A. Gray
Gutierrezia alamanii A. Gray var. *megalocephala* (Fernald) M.A. Lane

Gutierrezia wrightii A. Gray
Gymnosperma glutinosum (Sprengel) Lessing
Helianthus petiolaris Nuttall
Heterotheca subaxillaris (Lamarck) Britton & Rusby
Hieracium crepidispermum Fries
Hieracium fendleri Schultz-Bipontinus
Hymenoclea sp.
Hymenothrix wrightii A. Gray
Lactuca graminifolia Michaux
Leibnitzia seemannii (Schultz-Bipontinus) Nesom
Machaeranthera sp. 1
Machaeranthera sp. 2
Melampodium longicorne A. Gray
Psilactis gentryi (Standley) Morgan
Ratibida mexicana (S. Watson) Sharp
Senecio carlomasonii B. Turner & T. Barkley
Senecio flaccidus Lessing var. *douglasii* (DC.) B. Turner & T. Barkley
Senecio neomexicanus A. Gray
Senecio parryi A. Gray
Senecio wootoni Greene
Solidago scabrida DC.
Solidago wrightii A. Gray var. *adenophora* Blake
Stevia serrata Cavanilles var. *serrata*
Tagetes lemmoni A. Gray
Thelesperma megapotamicum (Sprengel) Kuntze
Verbesina longifolia A. Gray
Viguiera annua (Jones) Blake
Viquiera multiflora (Nuttall) Blake var. *multiflora*
Xanthium strumarium L.
Zinnia peruviana L.

Betulaceae
Alnus oblongifolia Torrey

Bignoniaceae
Chilopsis linearis (Cavanilles) Sweet ssp. *arcuata* (Fosberg) Henrickson

Boraginaceae
Lithospermum cobrense Greene
Macromeria viridiflora DC

Brassicaceae
Draba petrophila Greene var. *viridis* (Heller) C.L. Hitchcock
Erysimum capitatum (Douglas) Greene
Lepidium thurberi Wooton
**Rorippa nasturtium-aquaticum* (L.) Hayek
Schoenecrambe linearifolia (A. Gray) Rollins
Thlaspi montanum L. var. *montanum*

Cactaceae
Coryphantha recurvata (Engelmann) Britton & Rose
Echinocereus cf. *coccineus* Engelmann
Echinocereus rigidissimus Rose
Opuntia cf. *engelmannii* Salm-Dyck
Opuntia spinosior (Engelmann & Bigelow) Toumey
Opuntia cf. *versicolor* Engelmann

Campanulaceae
Lobelia anatina Wimmer

Caparaceae
Polanisia dodecandra (L.) DC.

Caprifoliaceae
Lonicera sp.
Sambucus sp.
Symphoricarpos oreophilus A. Gray var. *oreophilus*

Caryophyllaceae
Arenaria lanuginosa (Michaux) Rohrbach ssp. *saxosa* (A. Gray) Maguire
Arenaria stricta Michaux ssp. *texana* (Robinson) Maguire
Drymaria leptophylla (Chamisso & Schlechtendal) Rohrb. var. *nodosa* (Engelmann) J. Duke
Silene laciniata Cavanilles var. *greggii* A. Gray

Chenopodiaceae
Chenopodium incisum Poiret
**Salsola kali* L.

Cochlospermaceae
Amoreuxia palmatifida Moçino & Sessé

Commelinaceae
Commelina dianthifolia Delile
Tinantia erecta (Jacquin) Schlechtendal

Convallariaceae
Smilacina racemosa (L.) Desfontaines
Smilacina stellata (L.) Desfontaines

Convolvulaceae
Convolvulus equitans Bentham
Evolvulus arizonicus A. Gray
Ipomoea longifolia Bentham
Ipomoea thurberi A. Gray

Crassulaceae
Sedum stelliforme S. Watson

Cucurbitaceae
Apodanthera undulata A. Gray
Cucurbita foetidissima H.B.K.

Cupressaceae
Juniperus deppeana Steudel
Juniperus coahuilensis (Martinez) Gaussen *ex* R.P. Adams
Juniperus scopulorum Sargent

Cyperaceae
Cyperus cf. *hermaphroditis* (Jacquin) Standley
Cyperus cf. *pringlei* Britton
Cyperus rusbyi Britton
Eleocharis montevidensis Kunth

Dennstaedtiaceae
Pteridium aquilinum (L.) Kuhn var. *pubescens* Underwood

Dryopteridaceae
Cystopteris fragilis (L.) Bernh.
Woodsia cochisensis Windham

Equisetaceae
Equisetum sp.

Ericaceae
Arbutus arizonica (A. Gray) Sargent
Arctostaphylos pungens H.B.K.
Chimaphila maculata (L.) Pursh
Monotropa hypopitys L.

Euphorbiaceae
Acalypha lindheimeri Müller-Argoviensis
Cnidoscolus angustidens Torrey
Croton texensis (Klotsch) Müller-Argoviensis
Euphorbia alta Norton
Euphorbia melanadenia Torrey
Euphorbia pediculifera Engelmann var. *pediculifera*
Jatropha macrorhiza Bentham
Tragia laciniata (Torrey) Müller-Argoviensis

Fabaceae
Acacia angustissima (Mill.) Kuntze
Amorpha fruticosa L.
Astragalus nothoxys A. Gray
Calliandra eriophylla Bentham
Chamaecrista serpens (L.) Greene var. *wrightii* (A. Gray) Irwin & Barneby
Cologania angustifolia H.B.K.
Cologania obovata Schlechtendahl
Coursetia caribea (Jacquin) Lavin var. *sericea* (A. Gray) Lavin
Dalea cf. *candida* (Michaux) Willdenow
Dalea filiformis A. Gray
Dalea versicolor Zuccarini var. *sessilis* (A. Gray) Barneby
Desmanthus cooleyi (Eaton) Trelease
Desmodium grahami A. Gray
Erythrina flabelliformis Kearney
Eysenhardtia orthocarpa (A. Gray) S. Watson var. *orthocarpa*
Galactia wrightii A. Gray
Hoffmanseggia glauca (Ortega) Eifert
Lathyrus lanzwertii Kellog var. *leucanthus* (Rydberg) Dorn
Lotus oroboides (H.B.K.) Ottley
Lupinus huachucanus Jones
Lupinus sp.
**Medicago sativa* L.
Mimosa cf. *aculeaticarpa* Ortega
Mimosa dysocarpa Bentham
Mimosa grahamii A. Gray var. *grahamii*
Phaseolus sp.
Prosopis cf. *velutina* Wooton
Rhyncosia senna Gilles *ex* Hooker var. *texana* (Torrey & Gray) M.C. Johnston
Robinia neomexicana A. Gray var. *neomexicana*
Tephrosia thurberi (Rydberg) C.E. Wood
Thermopsis montana Nuttall var. *montana*
Trifolium wormskioldii Lehm. var. *longicaule* (Wooton & Standley) L. Benson
Vicia pulchella H.B.K.

Fagaceae
Quercus arizonica Sargent
Quercus emoryi Torrey
Quercus gambelii Nuttall
Quercus hypoleucoides Camus
Quercus mcvaughii Spellenberg
Quercus oblongifolia Torrey
Quercus rugosa Née
Quercus viminea Trelease

Fouquieriaceae
Fouquieria splendens Engelmann ssp. *splendens*

Garryaceae
Garrya wrightii Torrey

Gentianaceae
Gentianella microcalyx (Lemmon) J.M. Gillett

Geraniaceae
Geranium caespitosum James
Geranium richardsonii Fischer & Trautvetter

Hydrangeaceae
Philadelphus microphyllus A. Gray

Hydrophyllaceae
Phacelia heterophylla Pursh

Iridaceae
Iris missouriensis Nuttall
Nemastylis tenuis (Herbert) Baker
Sisyrinchium scabrum Schlechtendahl & Chamisso

Juglandaceae
Juglans major (Torrey) Heller

Juncaceae
Juncus ensifolius Wikström var. *brunnescens* (Rydberg) Cronquist
Juncus tenuis Willdenow

Lamiaceae
Agastache pallida (Lindley) Cory var. *pallida*
Hedeoma sp.
**Marrubium vulgare* L.
Monarda citriodora Cervantes *ex* Lagasca ssp. *austromontana* (Epling) Scora
Salvia cf. *arizonica* A. Gray
Salvia lemmoni A. Gray
Salvia reflexa Hornemann
Stachys coccinea Jacquin
Trichostema arizonicum A. Gray

Liliaceae
Lilium parryi S. Watson

Linaceae
Linum lewisii Pursh
Linum puberulum (Engelmann) Heller

Loasaceae
Mentzelia sp.

Lythraceae
Lythrum californicum Torrey & Gray

Malpighiaceae
Aspicarpa hirtella L.C. Richard

Malvaceae
Gossypium thurberi Todaro
Sphaeralcea angustifolia (Cavanilles) G. Don

Melanthiaceae
Zigadenus virescens (H.B.K.) Macbride

Nolinaceae
Dasylirion wheeleri S. Watson
Nolina microcarpa S. Watson

Nyctaginaceae
Allionia incarnata L.

Oleaceae
Fraxinus gooddingii Little
Fraxinus pappilosa Lingelsheim
Fraxinus velutina Torrey

Onagraceae
Epilobium canum (Greene) Raven
Epilobium ciliatum Rafinesque ssp. *ciliatum*
Gaura sp.
Lopezia gracilis S. Watson
Oenothera elata H.B.K. ssp. *hirsutissima* (A. Gray) Dietrich
Oenothera laciniata Hill var. *pubescens* (Willdenow) Munz

Orchidaceae
Hexalectris sp.
Malaxis corymbosa (S. Watson) Kuntze
Malaxis ehrenbergii (Reichenbach) Kuntze
Malaxis macrostachya (Lexarza) Kuntze
Platanthera limosa Lindley

Ophioglossaceae
Botrychium virginianum (L.) Swartz

Orobanchaceae
Conopholis alpina Liebmann var. *mexicana* (A. Gray *ex* S. Watson) Haynes

Oxalidaceae
Oxalis cf. *albicans* Kunth ssp. *pilosa* (Nuttall) Eiten
Oxalis alpina (Rose) Kunth

Papaveraceae
Argemone pleiacantha Greene

Passifloraceae
Passiflora mexicana Jussieu

Phytolaccaceae
Rivina humilis L.

Pinaceae
Abies concolor (Gordon & Glendinning) Hoopes
Pinus cembroides Zuccarini
Pinus engelmannii Carrière
Pinus leiophylla Schiede & Deppe var. *chihuahuana* (Engelmann) Shaw
Pinus ponderosa Lawson var. *arizonicus* (Engelmann) Shaw
Pinus strobiformis Engelm.
**Pinus sylvestris* L.
Pseudotsuga menziesii (Mirbel) Franco

Plantaginaceae
**Plantago major* L.
Plantago patagonica Jacquin

Platanaceae
Platanus wrightii S. Watson

Poaceae
Aegopogon tenellus (Cavavilles) Trinius
Aristida adscensionis L.
Aristida arizonica Vasey
Aristida divaricata Humboldt & Bonpland
Aristida ternipes Cavanilles var. *hamulosa* (Henrard) Trent
Aristida ternipes Cavanilles var. *ternipes*
**Avena* cf. *fatua* L.
Blepharoneuron tricholepis (Nash) Torrey
Bothriochloa barbinodis (Lagasca) Herter
Bouteloua aristidoides (H.B.K.) Grisebach
Bouteloua curtipendula (Michaux) Torrey
Bouteloua gracilis (H.B.K.) Lagasca *ex* Steudel
Bouteloua hirsuta Lagasca
Bouteloua radicosa (Fournier) Griffths
Bromus anomalus Rupr. *ex* Fournier
Bromus ciliatus L.
Chloris virgata Swartz
**Cynodon dactylon* (L.) Persoon
**Digitaria sanguinalis* (L.) Scopoli
Echinochloa crusgalli (L.) Beauvois
Elymus arizonicus (Scribner & Smith) Gould
Elymus elymoides (Rafinesque) Swezey
Eragrostis intermedia A.S. Hitchcock
Eragrostis mexicana (Hornemann) Link var. *mexicana*
Eragrostis pectinacea (Michaux) Nees var. *miserrima* (Fournier) J. Reeder
Eragrostis pectinacea (Michaux) Nees var. *pectinacea*
Eriochloa acuminata (Presl) Kunth var. *minor* R.B. Shaw
Heteropogon contortus (L.) Beauvois
Koehleria macrantha (Ledeb.) Schultes
Leptochloa viscida (Scribner) Beal
Lycurus setosus (Nuttall) C. Reeder
Muhlenbergia longiligula A.S. Hitchcock
Muhlenbergia minutissima (Steudel) Swallen
Muhlenbergia montana (Nuttall) A.S. Hitchcock
Muhlenbergia pauciflora Buckley
Muhlenbergia repens (Presl) A.S. Hitchcock
Muhlenbergia rigida (H.B.K.) Trinius
Muhlenbergia sinuosa Swallen
Muhlenbergia trifida Hackel
Muhlenbergia wolfii (Vasey) Rydberg
Panicum bulbosum H.B.K.
Paspalum distichum L.
Piptochaetium fimbriatum (H.B.K.) A.S. Hitchcock
Piptochaetium pringlei (Beal) L. Parodi
**Polypogon viridis* (Gouan) Breistroffer
**Rhynchelytrum repens* (Willdenow) C.E. Hubbard
Setaria grisebachii Fournier
**Sorghum halapense* (L.) Persoon
Sporobolus cf. *airoides* Torrey

Polemoniaceae
Ipomopsis macombii (Torrey) V. Grant
Phlox nana Nutall var. *glabella* (A. Gray) Brand

Polygalaceae
Polygala obscura Bentham

Polygonaceae
Eriogonum jamesii Bentham var. *undulutam* (Bentham) Stokes
Eriogonum wrightii Torrey
Polygonum sp.
**Rumex crispus* L.
Rumex orthoneurus Rechinger

Portulacaceae
Talinum marginatum Greene

Potamogetonaceae
Potamogeton sp.

Primulaceae
Samolus vagans Greene

Ranunculaceae
Aquilegia chrysantha A. Gray
Clematis sp.
Delphinium andesicola Ewan
Delphinium tenuisecta Greene
Thalictrum fendleri A. Gray

Rhamnaceae
Ceanothus depressus Bentham
Condalia correlii M.C. Johnston
Rhamnus betulaefolia Greene

Rosaceae
Agrimonia striata Michaux
Cercocarpus brevifolius A. Gray var. *brevifolius*
Holodiscus dumosus (Nuttall) Heller var. *australis* (Heller) Ley
Potentilla thurberi A. Gray var. *atrorubens* (Rydberg) Kearney & Peebles
Prunus serotina Ehrhart ssp. *virens* (Wooton & Standley) McVaugh var. *rufula* (Wooton & Standley) McVaugh
Prunus serotina Ehrhart ssp. *virens* (Wooton & Standley) McVaugh var. *virens*

Rubiaceae
Bouvardia ternifolia (Cavanilles) Schlechtendal
Galium mexicanum Kunth ssp. *asperrimum* (A. Gray) Dempster
Galium pilosum Aiton
Galium wrightii A. Gray
Houstonia wrightii A. Gray

Rutaceae
Ptelea angustifolia Bentham

Salicaceae
Populus fremontii S. Watson ssp. *fremontii*
Populus tremuloides Michaux
Salix bonplandiana H.B.K.

Sapindaceae
Dodonea viscosa L.

Saxifragaceae
Heuchera sanguinea Engelmann

Scrophulariaceae
Castilleja austromontana Standley & Blumer
Castilleja patriotica Fernald
Castilleja tenuiflora Bentham
Mimulus cf. *cardinalis* Douglas
Mimulus guttatus DC.
Penstemon barbatus (Cavanilles) Roth ssp. *torreyi* (Bentham) Keck
Penstemon campanulatus (Cavanilles) Willdenow ssp. *chihuahuensis* Straw
Penstemon stenophyllus A. Gray
Seymeria bipinnatisecta Seemann

Solanaceae
Datura wrightii Regel
**Nicotiana glauca* Graham
Physalis sp.
Solanum eleagnifolium Cavanilles
Solanum cf. *rostratum*
Solanum sp.

Ulmaceae
Celtis reticulata Torrey
Valerianaceae
Valeriana arizonica A. Gray
Valeriana edulis Nuttall
Valeriana sorbifolia H.B.K.

Verbenaceae
Glandularia bipinnatifida (Nuttall) Nuttall var. *bipinnatifida*
Verbena carolina L.

Violaceae
Viola canadensis L.
Viscaceae
Phoradendron coryae Trelease
Vitaceae
Vitis arizonica Engelmann

Zygophyllaceae
Kalstroemia grandiflora Torrey