The Arizona Native Plant Society

The Plant Press

THE ARIZONA NATIVE PLANT SOCIETY

Volume 36, Number 1 Summer 2013

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Plants of the Madrean Archipelago

Plus

& Our Regular Features

Southwest Coralbean (*Erythrina flabelliformis*).

Floras in the Madrean Archipelago Conference

by Thomas R. Van Devender[1]. Photos courtesy the author.

Today the term 'bioblitz' is popular, meaning an intensive effort in a short period to document the diversity of animals and plants in an area. The first bioblitz in the southwestern United States was the 1848-1855 survey of the new boundary between the United States and Mexico after the Treaty of Guadalupe Hidalgo of 1848 ended the Mexican-American War. The border between El Paso, Texas and the Colorado River in Arizona was surveyed in 1855-1856, following the Gadsden Purchase in 1853. Besides surveying and marking the border with monuments, these were expeditions that made extensive animal and plant collections, often by U.S. Army physicians. Botanists John M. Bigelow (*Charphochaete bigelovii*), Charles C. Parry (*Agave parryi*), Arthur C. V. Schott (*Stephanomeria schotti*), Edmund K. Smith (*Rhamnus smithii*), George Thurber (*Stenocereus thurberi*), and Charles Wright (*Cheilanthes wrightii*) made the first systematic plant collection in the Arizona-Sonora borderlands.

In 1892-94, Edgar A. Mearns collected 30,000 animal and plant specimens on the second United States-Mexico Boundary Survey (Mearns 1907). On that expedition Lieutenant David Gaillard described the region as "*bare, jagged mountains rising out of the plains like islands from the sea*" (Hunt and Anderson 2002). Later Gaillard was the lead engineer on the

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President's Note *by Douglas Ripley,* jdougripley@gmail.com

As the new president of the Arizona Native Plant Society, it is a pleasure to introduce the Summer 2013 issue of *The Plant Press*. It is with great gratitude that we acknowledge the wonderful contributions of Barbara Phillips, the most recent past president as well as editor of the *The Plant Press.* Barbara's leadership, imagination, and willingness to work hard made *The Plant Press* a very fine publication.

I wish also to acknowledge the support of the new and re-elected members of the Board of Directors who were appointed in March 2013. Those include Andy Laurenzi (Vice President), Suzanne Cash (Secretary), Diane Kelly (Treasurer), and Ries Lindley and Mike Plagens (Directors-at-Large). And, of course, the returning Board Members, Cass Blodgett, Wendy Hodgson, Carianne Funicelli Campbell, Valerie Morrill, Andrew Salywon, and Sue Smith, are continuing their invaluable support and assistance to the Society.

Other volunteers who have helped keep the AZNPS running smoothly include Marilyn Hanson who for years has skillfully and conscientiously maintained the AZNPS' totally professional website, and Sue Carnahan, whose editorship of the *Happenings* is of the greatest benefit to our members. Anna Van Devender continues as our conscientious Administrative Assistant and Julie St. John will continue to do a great job of laying out *The Plant Press*. Her special knack for presentation makes for easy reading and eye-pleasing pages.

I and Ries Lindley (Tucson Chapter) have agreed to co-edit *The Plant Press*. We encourage members to provide input to keep the publication interesting and adaptable. Please contact us with ideas for themes, articles, book reviews, or any other information to make this publication continue to work for the members.

In May 2012, something important happened. Biologists, land planners, land managers, anthropologists, soil scientists, conservation ecologists, and people from many related fields came together for a conference called "Biodiversity and Management of the Madrean Archipelago III." The conference made waves in the science community, especially in Arizona and Sonora, and even though it did not make national science news like a two-faced kitten or the discovery of a gene for a rare disease, this gathering represented what works about science: diligence, hard work, attention to detail, and communication.

This issue features selected work and botanical abstracts from the Madrean Archipelago III conference. Tom Van Devender's introduction to the topic includes a short history of biological science in the Madrean Archipelago, background on the conference itself, and some provocative food for thought. A selection of abstracts on botanical subjects from the written offerings of the conference is included. These brief overviews of important work provide us with questions, answers, and a hunger for more.

The second featured paper, by Andy Laurenzi and John R. Spence, is a detailed discussion of a carefully crafted method for determining the conservation status of Arizona native plants. The protocol they present provides a potentially very valuable new tool for the identification and assessment of Arizona's rare native plants.

The new editors of *The Plant Press* wonder if a change in the name of our journal might be in order. In March 1977, Volume 1, number 1 of this publication was called *Newsletter of the Arizona Native Plant Society*. Later it was changed to *Bulletin of the Arizona Native Plant Society*. In 1981 the name was changed to *The Plant Press*. The name is catchy and says something about what the society is about. It could possibly say more, by including the state name in the title or by invoking an iconic state plant species name (either common or scientific) as has been commonly done by other native plant society journals and newsletters. Examples from some other western native plant societies are: *Mentzelia* (Nevada), *Sego Lily* (Utah), *Fremontia* (California) *Madroño* (California Botanical Society), *Kalmiopsis* (Oregon), *Aquillegia* (Colorado), *Kelseya* (Montana), and *Douglasia* (Washington). Some ideas for new names that would reflect Arizona or Arizona's native plants include: *Arizonica*, *Palo Verde* (state tree), or *Saguaro* (state flower).

Finally, you will notice that this issue of *The Plant Press* has a new appearance. It has been printed by a digital technology, rather than by the previous offset lithography method. The new printing method allows for the use of paper with a higher recycled content, the appearance of figures in full color, and is less expensive to print than the offset method. We hope you like it.

Please let us know your thoughts: Doug Ripley (jdougripley@gmail.com) and Ries Lindley (ries.lindley@gmail.com)

above Chihuahuan White Pine, "Pino Blanco" (*Pinus strobiformis*). *Courtesy Tom Van Devender.*

left Pine-Oak Vista in the Madrean Archipelago. right Mexican Yellowshow (*Amoreuxia palmatifida*).

Floras in the Madrean Archipelago Conference *continued*

construction of the Panama Canal. Weldon Heald, a resident of the Chiricahua Mountains, coined the term Sky Islands for the ranges in southeastern Arizona (Heald 1951). In 1981, Frederick H. Gehlbach's book *Mountain Islands and Desert Seas: A Natural History of the US-Mexican Borderlands* discussed Sky Islands in the southwestern United States.

With these conferences we now have a baseline for future studies and conservation initiatives.

In 2007, Conservation International named the Madrean Pine-oak Woodlands as a global biodiversity hotspot. This area included the Sierra Madre Oriental in eastern Mexico, the Sierra Madre Occidental in western Mexico, and the Sky Island ranges to the north in Arizona and New Mexico, and Texas. The Sierra Madre Occidental extends in western Mexico from Zacatecas and Jalisco north to Chihuahua and Sonora. The southwestern United States is famous for its diversity of amphibians and reptiles, and in general diversity increases southward in Sonora into the Sierra Madre Occidental and the New World tropics.

In a biogeographical analysis of the herpetofauna of Saguaro National Monument, University of Arizona herpetologist and ecologist Charles H. Lowe was probably the first to use the term "Madrean Archipelago" to describe the Sky Island ranges between the Sierra Madre Occidental in Sonora and Chihuahua and the Mogollon Rim of central Arizona (Lowe 1992). In September 1994, a conference entitled "Biodiversity and Management of the Madrean archipelago: The Sky Islands of Southwestern United States and Northwestern Mexico" was organized by the Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service, along with the Sky Island Alliance (DeBano *et al.* 1995). There were 69 presentations and 20 posters, with eight of them on floristic topics. There were overviews of the Sky Island Region/Madrean Archipelago authored by Peter Warshall, Robert Bye, Richard S. Felger and Michael F. Wilson, and Stephen P. McLaughlin. There were floras of the Huachuca Mountains of Arizona (Janice E. Bowers and McLaughlin) and the Sierra de los Ajos of Sonora (Mark Fishbein, Felger, and others).

The second Madrean Archipelago Conference in May 2004 was entitled "Connecting Mountain Islands and Desert Seas: Biodiversity and Management of the Madrean Archipelago" (Gottfried *et al.* 2005). There were 93 presentations and 14 posters, with at least six important floristic contributions. Laura Arriaga gave an overview on the floristic richness and conservation of northern Mexico. Floras were presented for the San Pedro River of Arizona (Elizabeth Makings) and *La Frontera* (Van Devender and Ana L. Reina-Guerrero), Sierra el Humo (Aaron D. Flesch and Lisa A. Hahn), and Sierra de Mazatán (J. Jesús Sánchez-Escalante *et al.*) of Sonora. The flora of the Huachuca Mountains was compared with that of the Yécora area in the Sierra Madre Occidental in eastern Sonora (Van Devender and Reina-G.)

In May 2012, the third installment of the Madrean Archipelago conference was entitled "Merging Science and Management in a Rapidly Changing World: Biodiversity and Management of the Madrean Archipelago III" which assembled the current state of our knowledge about the unique natural and cultural resources of the Madrean region and continued the discussion with the 24 sponsoring organizations of management practices useful for maintaining those resources. It brought together researchers, partners in resource stewardship, land managers,

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Floras in the Madrean Archipelago Conference

continued

educators and students, government officials, consultants, and the interested public from both sides of the border to examine the Madrean Archipelago of the southwestern United States and northwestern Mexico. The conference was an opportunity to achieve more collaboration through discussion of active projects and future research and management needs. There were 187 presentations and posters. Abstracts for 11 floristic topics are presented in the following pages. The proceedings volume will be published in 2013 (Gottfried *et al.* 2013). An overview of the Madrean Archipelago was presented by Van Devender and others that included a new map of the Sky Islands by Nicholas S. Deyo and Alex Smith. Floras were presented for Chihuahuan desertscrub in the Sierra Anibácachi and 15 other sites (Reina-G., Van Devender, and Sánchez-E.), Ciénega de Saracachi (Van Devender *et al.*), Ojo de Tonibabi (Melissa Valenzuela *et al.*), Rancho el Aribabi (Sánchez-E. *et al.*), Rancho el Rodeo (Ana L. Hernández-Rodríguez *et al.*), and the Sierra Bacadéhuachi (Van Devender *et al.*), all in Sonora. The foothills thornscrub floras of the Sierra la Madera and the Yécora area were compared (Van Devender *et al.*). George M. Ferguson and others summarized the biogeography of pines in the Madrean Archipelago. Citlali Cortés-Montaño and others presented on old growth forest flora, ecology, and conservation in the Sierra Madre Occidental in eastern Chihuahua. M. Socorro González-Elizondo and others presented an overview of the ecosystems and biodiversity of the Sierra Madre Occidental.

As recently as two decades ago, few people knew of the Madrean Archipelago as a distinct region and the evidence for its importance was scattered among many disciplines in two countries. These three conferences and their proceedings are major contributions to understanding the biodiversity of this region, but are really just the starting point for future natural history studies and a baseline for conservation initiatives.

Hierba de Piojo (*Mandevilla foliosa*).

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Abstracts of Botanical Papers Presented in the Madrean Archipelago Conference

Photos courtesy Tom Van Devender.

Flora of the Rancho Los Fresnos grasslands: A high-desert crossroads between the Sonoran, Chihuahuan and Great Plains floras. Brad Boyle. *University of Arizona, Department of Ecology and Evolutionary Biology, Tucson, AZ 85721.*

Rancho Los Fresnos, a private nature preserve at approximately 1,500 m along the US border in northern Sonora, protects over 4,000 hectares of desert grasslands, oak woodland and riparian vegetation along the headwaters of the San Pedro River. The Los Fresnos flora consists of 245 species in 65 families, with over a third of these species in the three families Poaceae, Asteraceae, and Fabaceae. Approximately 70% of the species are perennial. Blooming is distributed roughly bimodally between spring and fall, with a slight preponderance of fall-blooming species. Due to the presence of springs, permanent streams, and a large marsh or *ciénega*, Los Fresnos has a relatively rich riparian flora. Two species, *Lilaeopsis schaffneriana* subsp. *recurva* and *Echeandia flavescens*, are listed as threatened or endangered in the U.S. Seven species, among them *Sporobolus giganteus*, are apparently new records for the state of Sonora. Multivariate comparison of Los Fresnos with 246 North American floras showed almost equal floristic affinity with adjacent Sonoran deserts and Chihuahuan desert floras of NM, TX and north-central Mexico, as well as to short grass prairies of the SW Great Plains and semi-arid sites in central Mexico.

Biogeography and diversity of pines in the Madrean Archipelago. George M. Ferguson[1], Aaron D. Flesch[2], and Thomas R. Van Devender[3]. *[1]University of Arizona, Tucson, Arizona 85721, USA; [2]Avian Science Center, Division of Biological Sciences, 32 Campus Drive, University of Montana, Missoula, Montana 59812; [3]Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717, USA.*

Pines are important dominants in pine-oak and mixed-conifer forest in the Sierra Madre Occidental (SMO) and in the Sky Islands in the United States and México. Of the 15 native species of pines that occur in this region, most (11) have affinities to Madrean biotic communities of the SMO in México; four have affinities with Great Basin and Rocky Mountains biotic communities in the United States. In general, the diversity and density of pines increases with the area and elevation range of mountain ranges. Lower and smaller ranges have 0-4 species; higher ranges (>1 km^2 above 2,300 m elevation) have 4-7 species. With 11 species in the Municipio de Yécora eastern Sonora, the diversity of pines in the SMO is higher than any Sky Island. *Pinus arizonica* and *P. engelmannii* are common in pine-oak forest, while *P. strobiformis* is typical of mixed-conifer forest. Several species of pines reach the margins of their geographic ranges in the region, such as *P. ponderosa* var. *scopulorum* in the Sierra San José near the Arizona border, and *P. cembroides* and *P. lumholtzii* in the Yécora area; *P. yecorensis* in the Sierras de Bacadéhuachi and Huachinera are range extensions from the SMO. The Eurasian *P. sylvestris* is locally introduced in the Sierra de los Ajos.

Ecosystems and diversity of the Sierra Madre Occidental. M. S. González-Elizondo, M. González-Elizondo, L. Ruacho-González, I. L. López-Enríquez, F. I. Retana-Rentería, and J. A. Tena-Flores. *CIIDIR I.P.N., Sigma 119 Fracc. 20 de Noviembre II, Durango, Durango, 34220, Mexico.*

The ecosystems and vegetation of the Sierra Madre Occidental (SMO) were mapped using ArcView, based on Landsat images and field verification. Data on the composition, distribution and ecological determinism of the vegetation are presented. The Sierra Madre Occidental is the biggest continuous ignimbrite plate on Earth. With a complex geological history and a high biological and cultural diversity, it is a biological corridor, a barrier for the surrounding elements, and an active center of speciation, yet ecologically not well known. We describe the vegetation of the SMO above 1,800 m elevation. Ecosystems are described along a gradient from tropical deciduous forests to high montane communities. The most widespread communities are the Madrean pine-oak forests and woodlands. Among the dramatic changes occurring—besides fragmentation and deforestation driven by humans—are the effects of bark beetle (*Dendroctonus*) infestations that have killed extensive areas of pines (and also affected fir, Douglas-fir and spruce), which were likely already stressed by drought. Other changes included the expansion of chaparral driven by disturbance and the dwindling of oak woodlands, which are being replaced by *Dodonaea viscosa*, an invader from warmer areas.

Floristic analysis of a vegetation island and biological corridor in Sonora, Mexico. Ana Lilia Hernández-Rodríguez, María de la Paz Montañez-Armenta, Hugo Silva-Kurumiya, and Gertrudis Yanes-Arvayo. *Universidad de la Sierra, División de Ciencias Biológicas, Moctezuma, Sonora, México.*

We performed a floristic study of the vegetation islands on the mountain town of Montezuma, Sonora. From August to December 2011, the relevé method was used on ranches El Rodeo and Basora. The sites are located ca. 900 m elevation in foothills thornscrub. We collected a total of 85 species in 70 genera and 30 families. The species were identified through expert advice, literature, and comparison with specimens in the Herbarium of the Universidad de Sonora Herbarium (USON)

continued

Abstracts *continued*

in Hermosillo. Specimens were deposited into USON. The best represented families are Asteraceae, Convolvulaceae, Fabaceae, and Solanaceae. The study area is a transition zone between subtropical thornscrub and Sierra Madrean forest elements, making it an important biological corridor for the Sky Islands. It was found that the loss of flora is high due to changing land use, mainly the invasion of buffelgrass (*Pennisetum ciliare*). Representative species of the area such as *Zinnia zinnioides*, *Ipomoea cristulata, I. hederacea*, and *Abutilon*, can be replaced by species that have adapted to new local conditions.

Flora of the Limestone Sierra Anibácachi, Municipio de Agua Prieta, Sonora. Ana Lilia Reina-Guerrero and Thomas R. Van Devender. *Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717.*

A total of 590 plant collections were made in the La Calera area in northeastern Sonora on 20 trips in 2002-2008. The 25 km^2 (2.5 km^2 extensively inventoried) area in the Sierra Anibácachi, Municipio de Agua Prieta, is 11 km south of the Arizona border (31°13'59"N 109°37'53"W, ca. 1,287 m elevation). Chihuahuan desertscrub on limestone substrates is dominated by creosotebush (*Larrrea divaricata*), Chihuahuan whitethorn (*Acacia neovernicosa*), mariola (*Parthenium incanum*), and tarbush (*Flourensia cernua*). Riparian vegetation along a rocky bedrock/gravel wash includes desert willow (*Chilopsis linearis*), netleaf hackberry (*Celtis reticulata*), desert hackberry (*C. pallida*), woolly buckthorn (*Sideroxylon lanuginosa*), soaptree yucca (*Yucca elata*), Arizona walnut (*Juglans major*), and Coahuila juniper (*Juniperus coahuilensis*). The flora is diverse with 334 taxa in 62 families. The most important plants are in the Poaceae (58 taxa), Asteraceae (48), Fabaceae (24), and Malvaceae (23). Other genera with multiple species include *Euphorbia* (11), *Abutilon* (7), *Bouteloua* (7), *Eragrostis* (6), *Ipomoea* (6), and *Muhlenbergia* (6). Ten species are the first records for the state of Sonora, including *Chamaesaracha sordida*, *Cyphomeris gypsophiloides, Hybanthus verticillatus, Physaria fendleri, Quercus pungens, Ruellia parryi, Sphaeralcea polychroma,* and *Vicia ludoviciana.* Other noteworthy Sonoran records include *Bernardia myricaefolia*, *Dalea formosa*, *Phyllanthus polygonoides,* and *Vauquelinia californica* ssp. *pauciflora,* among others.

Handbasin Oak (*Quercus tarahumara*).

Vascular plants of El Aribabi Conservation Ranch: Plant diversity of a private natural protected area in northern Sonora, México. José Jesús Sánchez-Escalante, Denise Zulema Ávila-Jiménez, David Alfredo Delgado-Zamora, and Liliana Armenta-Cota. *Departamento de Investigaciones Científicas y Tecnológicas (DICTUS), Universidad de Sonora, Blvd. Luis Encinas y Rosales CP 83000 Hermosillo, Sonora.*

In northeastern Sonora, isolated mountains or sky islands are recognized for their high biodiversity, which sustains vegetal communities like desert scrub, natural grasslands, oak woodlands and pine-oak forests. Within this region (30°51'14.59"N, 110°41'11.91"W and 30°48'29.82"N, 110°32'5.59"W) is located El Aribabi Conservation Ranch. The flora of the ranch is based on more than 1,000 herbarium specimens collected by the Universidad de Sonora herbarium (USON) and observations records from the MABA (Madrean Archipelago Biodiversity Assessment) database. The flora inclues 454 vascular plants belonging to 87 families and 279 genera. Families with the greatest number of species are Asteraceae (65), Poaceae (41), Fabaceae (37), Euphorbiaceae (18), Malvaceae (13), Cactaceae (11) and 9 species in two fern families. Only two species of the flora are nominated with risk category by Norma Oficial Mexicana NOM-059. Non-native plants (27) represent 6% of the flora and only 6 are invasive. This work was carried out with financial support from the CONABIO and is important for its contribution to knowledge of the flora of the northern border. The ranch was recently declared a private protected natural area by the CONANP.

Floristic analysis of Ojo de Agua Tonibabi, Sierra La Madera, Sonora, Mexico. Melissa Valenzuela-Yánez[1], Gertrudis Yanes-Arvayo[1], Maria de la Paz Montañez-Armenta[1], Hugo Silva-Kurumiya[1], and Thomas R. Van Devender[2]. *[1]Universidad de la Sierra, División de Ciencias Biológicas, Moctezuma, Sonora, México; [2] Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717 USA.*

Ojo de Agua Tonibabi is an area of great historical and biological interest located 16 km northeast of Moctezuma, Sonora, Mexico at the base of the Sierra La Madera (29°48'10"N 109°40'49"W, 624 m elevation). Plants were collected, observed, and photographed to document floristic diversity in the area on six outings between April and November 2011. The vegetation is tropical foothills thornscrub. In the areas surrounding the spring and permanent streams, there is riparian vegetation with Goodding willow (*Salix gooddingii*). Collections were identified through comparisons with specimens in University of Arizona and the Universidad de Sonora Herbaria. A total of 143 species in 114 genera and 42 families were identified. The families with the greatest number of species are Fabaceae (26), Asteraceae (15), Euphorbiaceae

(11), Convolvulaceae (8), Poaceae (8), and Cactaceae (9). Annual plants are the most abundant life form (41 taxa), followed by perennial herbs (32), trees (22), shrubs (11), vines (9), succulents (9), grasses (8), subshrubs (7), and aquatic herbs (1).

Preliminary Flora of the Sierra Bacadéhuachi, Sonora, México. Thomas R. Van Devender[1], Ana Lilia Reina-Guerrero[1], George M. Ferguson[2], George Yatskievych[3], Beatriz E. Loyola-Reina[4], Gertrudis Yanes-Arvayo[5], John L. Anderson[6], Stephen F. Hale[7], Sky Jacobs[1], and Maria de la Paz Montañez-Armenta[5]. *[1]Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717 USA; [2]University of Arizona, Tucson, Arizona 85721, USA; [3]Missouri Botanical Garden, PO Box 299, St. Louis, Missouri 63110, USA; [4]JRM Consultores, Ave. Sonora 89, Col. Centro, Hermosillo, Sonora, México; [5]Universidad de la Sierra, División de Ciencias Biológicas, Moctezuma, Sonora, México; [6]Bureau of Land Management, 21605 North Seventh Ave. Phoenix, Arizona 85027, USA; [7]EcoPlan Associates, Inc., 701 W. Southern Ave., Suite 203, Mesa, Arizona 85210, USA.*

The Sierra de Bacadéhuachi in east-central Sonora is the westernmost mountain range in the Sierra Madre Occidental (SMO). They are located east of Bacadéhuachi, Municipio de Bacadéhuachi, 34 kilometers east of the Chihuahua border, and 164 km south of the Arizona border. The southern portion of the range is in the Ríos Nácori Chico and Riíto drainages, both part of the greater Río Yaqui system. The vegetation ranges from lowland foothills thornscrub up through desert grassland to oak woodland and pine-oak forest. The flora was sampled in December 1995 (montane forests); July 2008 (foothills thornscrub); and June, August, and September 2011, and March 2012 (Madrean Archipelago Biodiversity Assessment [MABA] Expeditions). The flora totals 379 taxa in 255 genera and 86 families. The most species-rich families and genera are Asteraceae (44 taxa), Fabaceae (44 taxa), Poaceae (30 taxa), *Quercus* (11 species), *Cheilanthes* (8 species), *Bouteloua* (6 species), and *Muhlenbergia* (6 species). Only 8 species are non-native (2.1%), 5 of them grasses. All observations and collections are in the MABA database (**www.madrean.org**). Although tree composition and structure of the upland woodlands and forests is similar to the Yécora area to the southeast, the preliminary Bacadéhuachi flora appears to be much less diverse.

Comparison of the tropical floras of Sierra la Madera and the Sierra Madre Occidental, Sonora, Mexico. Thomas R. Van Devender[1], Gertrudis Yanes-Arvayo[2], Ana Lilia Reina-Guerrero[1], Melissa Valenzuela-Yánez[2], Maria de la Paz Montañez-Armenta[2], and Hugo Silva-Kurumiya[2]. *[1]Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717 USA; [2]Universidad de la Sierra, División de Ciencias Biológicas. Moctezuma, Sonora, México.*

The floras of the tropical vegetation in the Sky Island Sierra la Madera (SMA) near Moctezuma in central Sonora (30°00'N 109°18'W) and the Yécora (YEC) area in the Sierra Madre Occidental (SMO) in eastern Sonora (28°25'N 109°15"W) were compared. The areas are 175 km apart. Tropical vegetation includes foothills thornscrub in both areas and tropical deciduous forest in the Yécora area. A total of 893 vascular plant taxa are known from these areas with 433 taxa in foothills thornscrub and 793 in tropical deciduous forest. Foothills thornscrub in SMA and YEC (near Curea) had 220 and 298 taxa, with most of them also in tropical deciduous forest (69.5% and 82.9%). Only 83 taxa in TDF were shared between SMA and YEC (37.7% and 27.9% of the floras). The 49 foothills thornscrub species in SMA but not YEC were not in tropical deciduous forest either, reflecting biotic influences from the Sonoran Desert (10), southwestern United States (8), Madrean Archipelago (6), and a few from oak woodland and tropical western Mexico. One species (*Pseudabutilon thurberi*) is endemic to central Sonora and adjacent Arizona. Affinities to the New World tropics are very strong in both areas. The structural dominants that define foothills thornscrub are widespread, but composition varies greatly locally.

Flora of Chihuahuan desertscrub on limestone in northeastern Sonora, Mexico. Thomas R. Van Devender[1], Ana Lilia Reina-Guerrero[1], and J. Jesús Sánchez-Escalante[2]. *[1]Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717, USA; [2] Departmento de Investigaciones Científicas y Tecnológicas, Universidad de Sonora, Av. Rosales y Niños Heroes s/n, Hermosillo, Sonora 83000, México.*

Transects were done in desertscrub on limestone to characterize the flora of the westernmost Chihuahuan Desert.

continued

Arizona Rosewood (*Vauquelinia californica*).

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Abstracts *continued*

Most of the sites (15) were in the Municipios of Agua Prieta and Naco in northeastern Sonora. Single sites were near Ascensión in northwestern Chihuahua and east of Douglas in southeastern Arizona. A total of 250 species were recorded on the transects. When analyzed by life form, perennial herbs (60 species) were the most numerous, followed by annual herbs (45 species), subshrubs (37 species), and woody shrubs (34 species). The most diverse limestone floras were on Rancho La Morita in the Municipio of Naco. Two transects on a hill west of Arroyo La Bellota had 90 and 121 taxa. Ocotillo (*Fouquieria splendens*), sotol (*Dasylirion wheeleri*), beargrass (*Nolina microcarpa*), and littleleaf sumac (*Rhus microphylla*) were dominants. On the nearby Cerro La Bruja transect (96 taxa), Chihuahuan whitethorn acacia (*Acacia neovernicosa*), ocotillo, and shrubby senna (*Senna wislizenii*) were common on a grassy, limestone slope. The flora was also diverse in the La Calera area on the Sierra Anibácachi in the Municipio of Agua Prieta with 93 taxa on a transect dominated by Sonoran rosewood (*Vauquelinia californica* var. *pauciflora*), a rare Sonoran shrub.

Biodiversity and conservation of the Ciénega de Saracachi area, Sonora, México. Thomas R. Van Devender[1], Martín A. Villa-Andrade[2], Martín Padrés-Contreras[3], Fernando Padrés[3], M. Reyes-Juárez[2], G. Luna-Salazar[2], and Paul S. Martin[4]. *[1]Sky Island Alliance, PO Box 41165, Tucson, Arizona 85717; [2]Comisión de Ecología Sustentable del Estado de Sonora, Reyes y Aguascalientes s/n Esq., Col. San Benito, Hermosillo, Sonora 83190; [3]Rancho Agua Fría, Ave. 5 de Mayo # 213 Norte, Magdalena, Sonora 84160; [4]Department of Geosciences, University of Arizona, Tucson, Arizona 85721.*

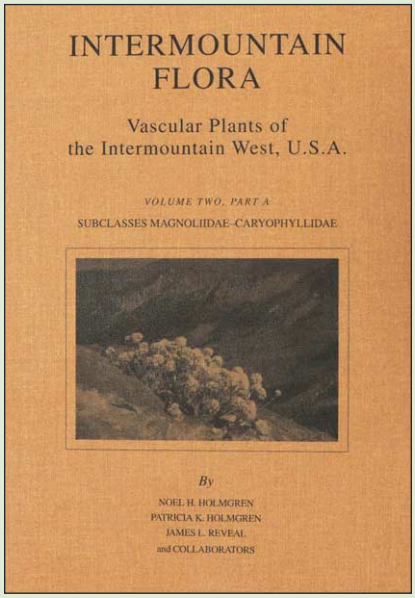
The Ciénega de Saracachi area, including Arroyos Santo Domingo and Quemado and Rancho la Brisca, is in north-central Sonora (30°22'N 110°25"W; 79 km² area; 960-1,000 m elevation) ca. 100 km south of the Arizona border in the Municipio de Cucurpe. The vegetation is desert grassland on slopes and cottonwood-willow riparian forest in the Ciénega and rocky stream canyons. These upper tributaries of the Río San Miguel are natural corridors on the west side of the Sierras San Antonio and Azul. The high diversity of the area has been recognized since the mid-1970s. In April 2011, a Madrean Archipelago Biodiversity Assessment (MABA) Expedition provided additional species documentation. In the MABA database (**www.madrean.org**), there are 434 species of plants in 105 families and 271 species of animals in 81 families documented in the area. Invertebrate animals with only 98 taxa in 23 families are very poorly known. Vertebrate animals with 172 species in 58 families are dominated by birds (77.9% of the species). Additional documentation is needed for plants, amphibians, and reptiles (especially snakes) in the summer rainy season, for migratory birds, and for invertebrates and mammals (especially bats) in general. About 10 species of animals are listed as Threatened or Of Special Concern in the NOM-059-SEMARNAT-2010 (the Mexican endangered species law). The La Brisca talussnail (*Sonorella aguafriensis*) is endemic to Arroyo Santo Domingo. Several species of plants and grasshoppers are only known in Sonora from the Ciénega. In 2010, the Saracachi area was nominated to be a Sonoran Área Natural Protegida to preserve its natural values and to develop ecotourism land-use options.

BOOK REVIEW *by Ries Lindley*

Intermountain Flora: Vascular Plants of the Intermountain West, USA

Volume 2, Part A Subclass Magnoliidae–Caryophyllidae, N. H. Holmgren *et al*. 2012.
742 pp. ISBN 978-0-89327-520-4. $150.00. NYBG Press.

This book is the last of an eight-volume flora begun decades ago. It covers the intermountain west, an area bounded by the Rocky Mountains, the Cascade Range, and the Sierra Nevada — roughly all of Utah and Nevada, the southern portions of Oregon and Idaho, and bits and pieces of Arizona, California, and Wyoming. The organization is based on Arthur Cronquist's taxonomic system and includes the Subclass Magnoliidae, with families like Ranunculaceae and Papaveraceae; Subclass Hamamelididae, including Fagacae, Ulmaceae, and others; and Subclass Caryophyllidae, including Polygonaceae, Chenopodiaceae, and more.



For the impatient, let's cut to the chase and say this looks like a very fine finish for a project of enormous proportions. For readers looking for good descriptions and excellent notes, this book will work especially well. Descriptions for each taxon are standardized, that is to say, the same terms are used in each account, are always in the same order, and are described with similar language. Notes appear at the end of each description in an easy-to-spot, different font. Standard terms are italicized, as in *leaf*, *inflorescence*, *sepal*, etc. Descriptions are thorough, detailed, understandable, and easy to compare.

The real magic in this flora is the near-perfect interweaving of the keys and illustrations. Keys enjoy a love-hate relationship with both authors and users. Authors cringe when the questions about terms start coming in, and users start feeling like they are drowning when they see undefined terms. In *Volume 2A*, there is a large, detailed, and beautiful illustration for each plant in the keys. This goes a long way toward mitigating any heartburn caused by special terms in the keys. For example, a lead in the cactus key for *Echinocereus mojavensis* (Mojave kingcup cactus) states that the spines are "papillose-setulose under 30x magnification," and the illustration for this species features a spine that has been magnified enough to show this feature. The illustrations also have helpful numbers indicating the factor of magnification for the different features. These factors are accurate for both the illustrations previously published in other works as well as those drawn for Volume 2A.

For those of you who don't want to learn the difference between the Cronquist taxonomy and any other system, there is good news; you don't need to. The plants are not aware of the different taxonomic organizational structures, so when you follow the keys through, you will still have a properly identified plant that you can look up later in any system you like. No doubt the vast proliferation of molecular work on plants in recent years has created new ideas about plant taxonomy, but not a lot of it has been useful for field grunts with threeawn in their socks. Cronquist gives us a system more suited to keys that work without the need of a plant physiology lab. The key leads use characters easily identifiable with a hand lens, a low-power microscope, or most often, the naked eye.

In about a year, the Intermountain series will include a supplement that will have a key to families and a cumulative index. This will be a real timesaver for readers who need to decide which volume to look in first. A family key would also do away with the need to understand the taxonomic system since it would bypass subclasses and orders, and a good index is always an important addition to any reference work.

There may be a short wish list for those in quest of a perfect flora. The book covers a pretty large area — probably about 250,000 square miles — and there are no range maps. The notes have good location information, but for visual learners, a map would be a real balm. Although the illustrations can be used to ferret out obscure terms, a glossary would be very useful. There is no going back to the individual volumes with a 40-year project like this, but the supplement presents a great opportunity for a glossary.

Intermountain Flora, Volume 2A, is a wonderful culmination to decades of careful thought, thorough planning, and first-rate botany. Decades from now, copies of this volume and its companions will be dog-eared and tattered from use, and many of the fingerprints, coffee stains, and plant fragments littering the pages will be new.

left Type specimen of *Castilleja lanata* deposited in the Gray Herbarium, Harvard University. *Courtesy the Digital Collection of the Harvard University Herbaria.* right and below *Castilleja lanata* in the Dragoon Mountains, Cochise County, Arizona. *Courtesy the author.*

SPOTLIGHT ON A NATIVE PLANT **Paintbrush *(Castilleja lanata)*** *by Douglas Ripley*

The Arizona paintbrushes are one of our most attractive and easily recognized wildflower genera. However, the identification of the individual 19 species occurring in Arizona can sometimes be challenging owing to the subtle morphological differences between them. There are approximately 200 species of these annual and perennial herbaceous plants and they occur mainly in the western Americas, extending from Alaska south to the Andes. All are considered hemiparasitic which means that they are parasitic under natural conditions, usually on the roots of grasses and forbs, but they are also photosynthetic to some degree. The paintbrushes were formerly classified in the Figwort Family (Scrophulariaceae) but are now placed in the Broomrape Family (Orobanchaceae). The genus was named in honor of the 18th century Spanish botanist Domino Castillejo by fellow countryman José Celestino Mutis, a botanical explorer and correspondent of Linnaeus.

Castilleja lanata, which I chose to represent all the Arizona Paintbrushes, occurs throughout central and southeastern Arizona, east to southern New Mexico and southwestern Texas, and south to the State of Coahuila, Mexico. In Arizona it occurs between 2,500 to 7,000 feet elevation, mainly on granitic or limestone slopes where it sometimes flowers throughout the year.

I chose *Castilleja lanata* because it has a very interesting botanical history in addition to its colorful and handsome flowers. It was first collected on May 17, 1851 by Charles Wright and John M. Bigelow in Kinney County, Texas. Wright and Bigelow were botanists assigned to the U.S. and Mexican Boundary Survey under the leadership of Major William H. Emory, U.S. Army. Their mission was to survey the United States and Mexico border immediately following the U.S.-Mexican War (1846-1849), as discussed in Tom Van Devender's paper in this issue. As with many of the plants collected on that expedition, their paintbrush specimens were sent to Dr. Asa Gray at Harvard University who formally described the species in the *Report of the U.S. Mexican Boundary Survey* (1859). The specific epithet *lanata* is derived from the Latin root *lanu*, referring to wool or down, as exhibited in the foliage. The type collection for *Castilleja lanata* is deposited in Harvard University's Gray Herbarium. Recently, the U.S. National Herbarium in the Smithsonian Institution's National Museum of Natural History, which holds duplicate collections from the U.S. and Mexican Boundary Survey, selected their specimen of *Castilleja lanata* as one of ten botanical treasures that exemplify the herbarium. The specimens were chosen based on having scientific, taxonomic, aesthetic, representative, historic, and/or cultural value.

Conservation Priority Setting for Arizona G1 and G2 Plant Species: A Regional Assessment

by Andy Laurenzi[1] and John R. Spence[2]

Introduction

The American Southwest supports one of the richest floras in North America, with perhaps as many as 6,000 indigenous species distributed among the deserts and mountains of the region. The area includes six major arid and semi-arid biomes: the Chihuahuan, Colorado Plateau, Great Basin, Mohave, and Sonoran Deserts, and the Madrean region that extends from Mexico into southern New Mexico and Arizona. A recent compilation of rare species in the Greater Southwest (Spence 2006, unpublished) has put the number of NatureServe G1 and G2-ranked (globally imperiled or globally threatened) species[1] at approximately 700. Nearly 200 of these 700 species occur in Arizona. New species are being discovered and described every year in the region.

While NatureServe and state heritage programs provide a clearinghouse and centralized data repository for information on rare plants and animals, the plethora of globally imperiled and threatened species in this region requires an additional level of analysis to assist rare plant conservation. The challenge is especially acute in Arizona. While the Arizona Game and Fish Department's Heritage Data Management System remains an exemplary centralized repository for information on rare plants, the Department's lack of statutory authority concerning native plants precludes the employment of botanical experts to assist in the management of rare plant information. Coupled with scarce funding for plant conservation and the small number of field botanists, there is a need to prioritize among these species to more efficiently allocate resources for conservation purposes. Many of these species are at risk of extinction, and there is an urgent need for regional botanists to share data, discuss information, and organize a coordinated and prioritized response to the conservation of rare plants.

The Priority Setting/Ranking System

Beginning with the International Union for the Conservation of Nature's Red List in the early 1960s, there have been many systems developed to assess the conservation status of species. All of the systems vary with respect to information required and the components examined[2]. This report focuses on two systems: the NatureServe ranking protocol initially developed by The Nature Conservancy and currently utilized by State Natural Heritage programs and Conservation Data Centers in North America and parts of the Caribbean, and the "Wyoming Protocol" developed by Walt Fertig and adopted by the Utah Native Plant Society (Fertig 2012).

Traditionally, NatureServe G ranks[3] were based on the number of global occurrences (discrete biological populations), abundance, or risk of extinction as determined by expert opinion (Master *et al.* 2000). Criticism of the system has included that the rankings were weighted towards occurrences in assigning rank numbers. Current NatureServe protocols have become more quantitative and consider additional ranking criteria, including long- and short-term trends, area of occupancy, condition of occurrences, intrinsic rarity, and threat (Regan *et al.* 2004), which suggests that this system alone could provide the finer-grained assessment required to develop a more rigorous priority-setting system. However, the complexity of the protocol limits its utility in Arizona where again the lack of a dedicated rare plant program constrains the effective employment of the NatureServe system. Currently in Arizona, most of the plant taxa ranks have not been updated in well over a decade (Sabra Tonn, Arizona Natural Heritage Program, pers. comm.). Despite these shortcomings, this system provides a good "first cut" of taxa to consider as target species for conservation priority setting.

In the "Wyoming Protocol" developed by Fertig (hereafter referred to as the "Fertig Approach"), taxa are assessed using seven criteria: distribution, number of populations, number of individuals, habitat specificity, intrinsic rarity, magnitude of threats, and population trend. Individual criteria are rated on a binary scale (0 for unthreatened, 1 for at risk) based on expert opinion. Species for which no data are available are scored "unknown." The values for each criterion are summed to derive a rank score and potential rank score for each taxon. The rank score is calculated by summing each individual score and treating any unknown criteria as 0. The potential rank score is derived in the same way, except that unknown criteria are given a value of 1. The two summary scores are averaged to determine a conservation priority rank. Those taxa that are at risk for a large number of criteria have higher conservation priority ranks than those species that are at risk for only a few criteria. Where three or more categories are unknown, significant data gaps exist and these taxa are identified as needing additional research.

Before deciding to employ the Fertig Approach, a second similar system proposed by Spence (2012) was initially proposed as part of this project. Both systems were discussed at the second meeting of the Southwest Rare Plant Task Force in December 2011. The consensus of the group was to employ the

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Conservation Priority Setting *continued*

Fertig Approach given its successful application in Utah and its binary scoring system within categories. Spence's approach is similar but requires more subjective judgment within each category in order to assign a score of 1, 2, or 3. Those who have used these kinds of ranking systems that require users to make multiple decisions based on inadequate information know that decision fatigue is common and in the long run becomes a significant disincentive for their use. Simplifying the decision process (i.e. the value assigned is a 1 or a 0 rather than a graduated scale) may be the most significant utility of the Fertig Approach.

Because this project is a regional assessment, the emphasis is to consider the status of a species throughout its range and not as conscribed by state boundaries. Accordingly, we modified the Fertig Approach to consider global distribution and the total number of populations and individuals throughout the species' range as opposed to the distribution, occurrences and abundance only in the state. The threshold for a score of 1 for the numbers of occurrences was also increased from 25 to 30 (Table 1). It is presumed that conservation actions undertaken in Arizona for these species will provide a significant contribution to species conservation overall.

Methodology

The initial list of plant species provided by the Arizona Heritage Data Management system in November 2011 included all taxa with a potential rank of G1 or G2, or T1 or T2 (for sub-species or varieties). For purposes of this report only, G1 and G2 taxa were considered but we anticipate that follow-on work will include the entire Arizona list of globally imperiled or globally threatened taxa. This list was compared to a similar list generated at the 2006 Southwestern Rare Plant Taskforce workshop and updated through the end of 2007 to determine if some taxa had inadvertently been overlooked in the 2011 list. A total of 189 G1 and G2 species were on this initial target list[4].

This first step was to review taxonomic nomenclature using the Integrated Taxonomic Information System (**www.itis.gov**), an easily accessible database with reliable information on species names and their hierarchical classification. Eleven species were dropped from further consideration because the taxonomic nomenclature used in the initial target list was no longer accepted and these species were subsumed within more widespread species that are not ranked G1 or G2 by

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Table 1. Ranking Category and Scoring Criteria

Distribution	**2**	**Local endemic** (global range less than 16,500 km^2 or about 1 degree of latitude x 2 degrees of longitude)
	1	**Regional endemic** (global range covering 16,501-250,000 km^2 or an area about the size of Wyoming)
	0	**Widespread** (occurs widely across portions of North America [covering more than 250,000 km^2])
Number of Occurrences	**1**	**Low** (fewer than 25 extant populations in state)
	0	**Medium to High** (25 or more extant populations in state)
Abundance	**1**	**Low** (depends on life history of species, but typically less than 30,000 individuals for perennials [higher numbers allowable for annuals] or occupying an area of less than 3,000 acres throughout its range)
	0	**Medium to High** (known from well over 30,000 individuals for perennials or occupying an area greater than 3,000 acres throughout its range)
Habitat Specificity	**1**	**High** ("Specialist" restricted to one or a few specialized geologic substrates, topographic environments situations, soil types, or vegetation types)
	0	**Medium to Low** ("Generalist" found in numerous geologic substrates, topographic environments soil types, or vegetation types)
Intrinsic Rarity	**1**	**High** (unusual life history, dependence on rare or specialized pollinators, poor dispersal, low fecundity, poor seedling survival, etc.)
	0	**Medium to Low** (no unusual life history or biological attributes limiting establishment or persistence)
Threats	**1**	**High** (current or foreseeable threats significant or broad in scale or scope)
	0	**Medium to Low** (threats minimal or limited to small percentage of populations now or in the foreseeable future)
Trends	**1**	**Decreasing** (short to long-term decline in number, size, or vigor of populations)
	0	**Increasing** (stable, or oscillating around a mean)

NatureServe (Appendix A, pages 15–17). Seven species were split into at least two sub-species or varieties and removed from the G1 and G2 list here (*Astragalus mokiacensis, Atriplex griffithsii, Carex curatorum, Choisya mollis, Coryphantha sneedi, Lesquerella kaibabensis, Pediomelum epipsilum,* and *Senecio multidentatus*). Three varieties were elevated to a full species (i.e. *Hexalectris spicata* var. *arizonica* now referred to as *H. arizonica*, *Hexalectrus revoluta* var. *colemanii* now referred to as *H. colemani,* and *Astragalus wootoni* var. *endopterus* now referred to as *A. endopterus*). Previously recognized varieties of four species (*Astragalus pinonis, Astragalus eurylobus, Lepidum integrifolium, Potentilla sanguinea*), are not considered valid, and four species were added that have been recently described (*Agave verdensis, Agave yavapaiensis, Alliciella cliffordii,* and *Mentzelia canyonensis).* One species, *Agave* x *arizonica,* a spontaneous hybrid, was not considered here.

The final target list of 176 species was then used to solicit expert opinion to score each species within each of the seven ranking categories based on criteria listed in Table 1. This occurred through personal meetings, telephone conversations, or by experts who filled out the ranking categories themselves. For species in which no expert was identified or consulted, we populated the rank system categories based on information provided by the Arizona Heritage Data Management System, the Southwest Environmental Information Network (SEINet) (**www.swbiodiversity.org**), and NatureServe (**www.natureserve.org**). In all instances where species occurred outside of Arizona, we consulted and incorporated, as appropriate, information on rare plants available in New Mexico through the New Mexico Rare Plant Council (**nmrareplants.unm.edu/rarelist.php**), the California Native Plant Society Inventory of Rare and Endangered Plants (**www.cnps.org/cnps/rareplants/inventory/index.php**), the Nevada Rare Plant Atlas (**heritage.nv.gov/atlas**), and the Utah Native Plant Society Rare Plant List (Fertig 2012).

In the case of the Utah list, rank data that were available were incorporated taking into consideration global distribution, occurrences, and abundance which in some instances revised the score. Arizona reports from 2003 to 2013, prepared through grants authorized in Section 6 of the U.S. Endangered Species Act, were reviewed for relevant information and in most instances Heritage Data Management System Element Abstracts were also consulted.

Results and Discussion

We classified plants in the same manner as Fertig (2012) based on the average between rank score and potential rank score rounded down. Our results were as follows:

Very High Priority — Rank Score of 7 or 8. Localized endemic plants species in need of immediate and focused conservation attention. If not already listed or proposed for listing as threatened or endangered should be given priority consideration for such listing. (10 species). Four of the ten species are currently listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or are a candidate for listing.

High Priority — Rank Score of 6. Vulnerable. No concerns in short-term but should be the focus of better data on threats and trends. (39 species). All should be included on agency sensitive species lists. Four are currently listed threatened or endangered by the USFWS or are a candidate for listing.

Watch — Rank Score of 5. Plants which are often locally abundant or widespread. If localized, distribution threats are low. (36 species). Two are currently listed threatened or endangered by USFWS or are a candidate for listing.

Likely Secure — Rank Score of 4 or less. None of these plants are currently listed threatened or endangered by the USFWS or are a candidate for listing.

Need Data — Rank Score in three or more categories are unknown. None of these plants are currently listed threatened or endangered by the USFWS or are a candidate for listing.

Peripheral — We determined that there were five species whose range in Arizona constitutes less than 5 percent of the relatively continuous range of the species. There is equivocal evidence that peripheral populations have significant conservation value (Lepig and White 2006), suggesting that the question of whether to include peripheral species should receive further consideration and remain on the list.

The final rank scores for all species listed in Very High Priority, High Priority and Watch rank categories are presented in Appendix B (pages 18–19). The complete list of rank assignment for all taxa can be found at **www.aznps.com**. The list presented here was the first iteration in Arizona using the Fertig Approach. These lists are inherently dynamic and hopefully the ease of using this tool will facilitate at least annual updates. Taxonomic considerations are always a challenge and undoubtedly some of the treatments here may not be acceptable to some researchers.

Geographic range, habitat specificity, number of occurrences, and abundance are well enough known or understood that a score of 1 or 0 was assigned in all but a few cases. Threats were less known and in many instances the assignment of a value for them was very much a subjective determination. In the absence of solid information some experts tended to be conservative and recommended a rank of 1. Exceptions occurred when habitat parameters (e.g. cliffs) or occurrences within large protected areas (e.g. Grand Canyon National Park) were known. Few plants have received the level of study regarding life history attributes (e.g. fecundity, seed viability, dispersal capacity and mechanisms, and pollinators) to allow experts to assign consistently an Intrinsic Rarity score, and many species received an unknown rank score as a result. However, population trend data were far and away the most difficult

continued

Conservation Priority Setting *continued*

ranking criterion to score. "Unknown" was used in 103 cases. It was very difficult to come by objective trend data or observations that were informed by more than irregular casual visits. The notable exceptions are the long-term monitoring conducted for many years by Lee Hughes of the Bureau of Land Management on the Arizona Strip District and more recently the work of the several Arizona National Forests — most notably the Coconino, Kaibab, and Prescott National Forests — which have been regularly monitoring select forest sensitive species. In some instances, expert opinion differed on threats and trend scores. We usually incorporated the rank that was likely to lead to a higher rank score unless information was available from one expert that clearly provided a rank score based on objective information.

Thirty eight of the 168 ranked species have documented occurrences in Mexico, which is nearly a quarter of the taxa under consideration. For these species, their distribution in Mexico adds another component of uncertainty with respect to their rank score. SEINet does include two Mexican herbaria in its centralized specimen database (**www.swbiodiversity.org**) but overall information on species occurrences in Mexico is less well known than occurrences in the United States for the experts who participated and for the information that is readily available.

Recommendations

1. Complete rank scoring for all T1 and T2 taxa and compile integrated list.
2. Convene Group of Invited Experts at Arizona Botany Meeting in February 2014 to review the current list including decisions to exclude certain species based on distribution and taxonomy.
3. Distribute this report and final G1, G2, T1, and T2 rank list to all agencies for their consideration in identifying species of concern or in the case of USFWS listing as threatened or endangered.
4. Direct volunteer efforts to inventory and monitor all Very High and Priority species. Particular attention should be directed to the establishment of regular monitoring plots to determine trends.
5. Identify major herbaria and systematically research plant specimens in Mexico.

Acknowledgements

We thank Sabra Tonn and her staff at the Arizona Heritage Data Management System for making all digital data on rare plants available for our use. We thank Walter Fertig for answering questions about the Fertig Approach and providing information on Utah rare plant scores. The following experts participated directly in the review process and their input was essential to the project: John Anderson, Mark Baker, Richard Felger, Wendy Hodgson, Lee Hughes, Elizabeth Makings, Barbara Phillips, Jackie Poole, Daniela Roth, and Tom Van Devender. The project was conducted with the financial support of the Section 6 program administered by the Arizona Department of Agriculture and the United States Fish & Wildlife Service. Julie Crawford and Shelley McMahon reviewed the draft report and provided helpful comments.

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[1] NatureServe protocol assigns full species a conservation rank on a scale of 1 (critically imperiled) to 5 (demonstrably secure) across their entire global range (G rank).

[2] Fertig (2012) and Spence (2012) provide substantive discussion on some of these systems along with contemporary thinking about the concept of species rarity. The reader is referred to these studies rather than our providing a synopsis here.

[3] Sub-species or varieties are ranked in a similar fashion and assigned ranks of T1 or T2 if they are considered globally imperiled or globally threatened.

[4] Eighteen species that were included in the Arizona Rare Plant Field Guide were not included here based on a ranking of G3. Fourteen species that were considered but not included in the Field Guide were included here.

APPENDIX A. Full List of Species Considered and Taxonomic Nomenclature (www. ltis.gov)

TAXON	CURRENT TAXONOMIC TREATMENT
Arabis tricornuta	*Pennellia tricornuta* (Rollins) R.A. Price, C.D. Bailey & Al-Shehbaz. Consider under this name.
Arceuthobium microcarpum	*Arceuthobium campylopodum* Engelm. Widespread drop from conisderation.
Arenaria aberrans	*Eremogone aberrans* (M.E. Jones) Ikonn.
Argemone arizonica	
Asclepias welshii	
Asplenium exiguum	
Astragalus ampullarius	
Astragalus beathii	
Astragalus endopterus	Formerly considered *Astragalus wootonii* var. *endopterus.* Consider as full species.
Astragalus eurylobus	Formerly considered *Astragalus tephrodes* var. *eurylobus* Barneby. Consider as full species.
Astragalus holmgreniorum	
Astragalus hypoxylus	
Astragalus mokiacensis	*Astragalus lentiginosus* var. *mokiacensis* (A. Gray) M.E. Jones. Remove from full species list.
Astragalus pinonis	Previous two varieties not taxonomically accepted. Consider as full species.
Astragalus septentriorema	
Astragalus sophoroides	
Arabis tricornuta	*Pennellia tricornuta* (Rollins) R.A. Price, C.D. Bailey & Al-Shehbaz. Consider under this name.
Arceuthobium microcarpum	*Arceuthobium campylopodum* Engelm. Widespread drop from conisderation.
Arenaria aberrans	*Eremogone aberrans* (M.E. Jones) Ikonn.
Argemone arizonica	
Asclepias welshii	
Asplenium exiguum	
Astragalus ampullarius	
Astragalus beathii	
Astragalus endopterus	Formerly considered *Astragalus wootonii* var. *endopterus*. Consider as full species.
Astragalus eurylobus	Formerly considered *Astragalus tephrodes* var. *eurylobus* Barneby. Consider as full species.
Astragalus holmgreniorum	
Astragalus hypoxylus	
Astragalus mokiacensis	*Astragalus lentiginosus* var. *mokiacensis* (A. Gray) M.E. Jones. Remove from full species list.
Astragalus pinonis	Previous two varieties not taxonomically accepted. Consider as full species.
Astragalus septentriorema	
Astragalus sophoroides	
Astragalus straturensis	
Astragalus troglodytus	
Atriplex griffithsii	*Atriplex torreyi* var. *griffithsii* (Standl.) G.D. Br. Remove from this full species list.
Berberis harrisoniana	
Brickellia baccharidea	
Browallia eludens	
Camissonia confertifolia	*Chylismia confertiflora* (P.H. Raven) W.L. Wagner & Hoch.
Carex curatorum	Formerly considered *Curatorum scirpoidea* var. *curatorum*. Consider as full species.
Carex specuicola	
Castilleja kaibabensis	
Castilleja mogollonica	*Castilleja sulphurea* Rydb. Widespread drop from further consideration.
Choisya mollis	*Choisya dumosa* var. *mollis* (Standl.) L.D. Benson. Drop from full species list.
Cirsium mohavense	
Cirsium rusbyi	*Cirsium mohavense* (Greene). Consider under this name.
Cirsium virginense	*Cirsium mohavense* (Greene). Consider under this name.
Cirsium wrightii	
Clematis palmeri	*Clematis bigelovii* Torr. Widespread drop from further consideration.
Cleome multicaulis	*Peritoma multicaulis* (DC.) Iltis. Not found in Arizona.
Conioselinum mexicanum	
Cordylanthus nevinii	
Coryphantha sneedii	*Escobaria sneedii* var. *sneedii* Britt. & Rose. Highly variable complex. Drop from full species list.
Crassula viridis	
Croton wigginsii	
Cryptantha atwoodii	
Cryptantha ganderi	
Cryptantha osterhoutii	
Cryptantha semiglabra	
Cuscuta dentatasquamata	
Cuscuta mitriformis	
Cuscuta odontolepis	
Cylindropuntia abyssi	
Cymopterus beckii	
Cymopterus davidsonii	*Pteryxia davidsonii* (J.M. Coult. & Rose) Mathias & Constance. Consider under this name.
Dalea tentaculoides	
Draba standleyi	
Dryopteris rossii	
Enceliopsis argophylla	
Ephedra funerea	
Ermeothera gouldii	
Ericameria arizonica	
Erigeron anchana	
Erigeron arisolius	
Erigeron compactus	
Erigeron heliographis	
Erigeron kuschei	

continued

APPENDIX A. Full List of Species Considered and Taxonomic Nomenclature (www. Itis.gov) *continued*

TAXON	CURRENT TAXONOMIC TREATMENT
Erigeron lemmonii	
Erigeron piscaticus	
Erigeron pringlei	
Erigeron rhizomatus	
Erigeron sivinskii	
Eriogonum darrovii	
Eriogonum jonesii	
Eriogonum mortonianum	
Eriogonum ripleyi	
Eriogonum terrenatum	
Eriogonum viscidulum	
Errazurizia rotundata	
Eryngium phyteumae	
Eryngium sparganophyllum	
Escobaria robbinsiorum	
Eupatorium bigelovii	*Chromolaena bigelovii* (A. Gray) R.M. King & H. Rob. Consider under this name.
Euphorbia aaron-rossii	
Flaveria mcdougallii	
Fraxinus papillosa	
Gentianella wislizeni	
Glandularia chiricahensis	
Grindelia laciniata	*Grindelia arizonica* A. Gray. Widespread drop from consideration.
Hackelia besseyi	
Hermannia pauciflora	
Heterotheca rutteri	
Heterotheca zionensis	
Hexalectris colemanii	Formerly considered *Hexalectris revoluta* var. *colemanii.* Consider as full species.
Hexalectris arizonica	Formerly considered *Hexalectris spicata* var. *arizonica*. Consider as full species.
Hexalectris warnockii	
Hieracium pringlei	
Hieracium rusbyi	*Hieracium abscissum* Less. Consider under this name.
Hymenoxys jamesii	
Imperata brevifolia	
Lepidium integrifolium	Formerly considered *L.i.* var. *integrifolium* Nutt. Consider as full species.
Lesquerella kaibabensis	*Physaria kingii* ssp. *kaibabensis* (Rollins) O'Kane. Remove from full species list.
Lesquerella navajoensis	*Physaria navajoensis* (O'Kane). Consider under this name.
Lupinus huachucanus	
Lupinus lemmonii	
Mabrya acerifolia	
Mentzelia memorabalis	
Mimulus dentilobus	
Muhlenbergia curtifolia	
Muhlenbergia dumosa	
Muhlenbergia dubiodes	*Muhlenbergia palmeri* Vasey. Consider under this name.
Myosurus nitidus	
Nissolia wislizeni	
Oenothera cavernae	
Opuntia martiniana	
Packera franciscana	
Packera quaerens	*Packera hartiana* (A. Heller) W.A. Weber & A. Löve. Ranked G3G4. Drop from further consideration.
Panicum mohavense	
Pediocactus bradyi	
Pediocactus paradinei	
Pediocactus sileri	
Pediomelum epipsilum	*Pediomelum megalanthum* var. *epipsilum* (Barneby) J.W. Grimes. Remove from full species list.
Pediomelum pauperitense	
Pediomelum pentaphyllum	
Pediomelum verdiensis	
Pellaea lyngholmii	
Penstemon albomarginatus	
Penstemon clutei	
Penstemon discolor	
Penstemon distans	
Penstemon nudiflorus	
Penstemon petiolatus	
Perityle ajoensis	
Perityle ambrosiifolia	
Perityle cochisensis	
Perityle congesta	
Perityle gracilis	
Perityle saxicola	
Perityle tenella	
Petalonyx parryi	
Phacelia buell-vivariensis	
Phacelia cronquistiana	
Phacelia howelliana	
Phacelia laxiflora	
Phacelia parishii	
Phacelia welshii	
Phaseolus supinus	*Macroptilium supinum* (Wiggins & Rollins) A. Delgado & L. Torres. Consider under this name.
Philadelphus crinitus	*Philadelphus microphyllus* var. *microphyllus* A. Gray. Widespread drop from further consideration.
Phlox amabilis	
Pholisma sonorae	
Physalis latiphysa	
Platanthera zothecina	
Potentilla albiflora	
Potentilla sanguinea	Formerly considered *Potentilla thurberi* var. *sanguinea* (Rydb.) Kearney & Peebles. Consider under this name.
Puccinellia parishii	

continued

APPENDIX A. Full List of Species Considered and Taxonomic Nomenclature (www. Itis.gov) *continued*

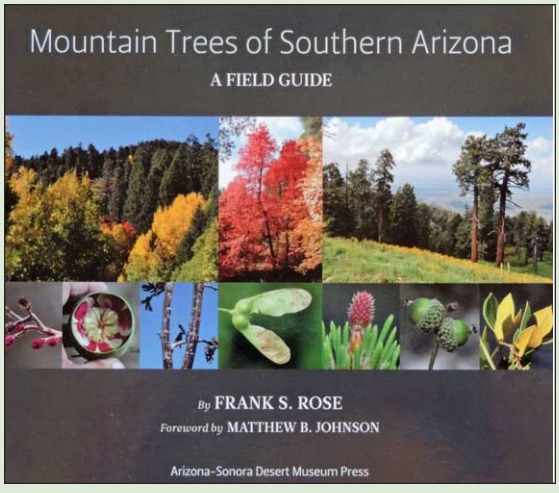
TAXON	CURRENT TAXONOMIC TREATMENT
Purshia subintegra	*Purshia* x *subintegra*
Salix arizonica	
Salvia amissa	
Salvia davidsonii	*Salvia henryi* A. Gray. Widespread drop from consideration.
Samolus vagans	
Sclerocactus sileri	*Sclerocactus spinosior* (Engelm.) Woodruff & L. Benson. Consider under this name.
Sclerocactus terrae-canyonae	
Sclerocactus whipplei	
Senecio multidentatus	Two varieties recgonized *S. m.* var. *huachucanus* and *multidentatus*. Drop from full species list.
Senecio quaerens	*Packera hartiana* (A. Heller) W.A. Weber & A. Löve. Widespread drop from consideration.
Silene rectiramea	
Sphaeralcea gierischii	
Spiranthes delitescens	
Stellaria porsildii	
Stephanomeria schottii	*Stephanomeria exigua* ssp. *exigua* Nutt. Widespread drop from further consideration.
Streptanthus lemmonii	*Caulanthus lemmonii* S. Watson.
Symphyotrichum potosinum	
Symphyotrichum welshii	
Talinum gooddingii	*Phemeranthus parviflorus* (Nutt.) Kiger. Widespread drop from further consideration.
Talinum humile	*Phemeranthus humilis* (Greene) Kiger. Consider under this name.
Talinum marginatum	*Phemeranthus marginatus* (Greene) Kiger. Consider under this name.
Tetraneuris verdiensis	
Thelypodiopsis ambigua	Previously recognized varieties no longer accepted. Consider as full species.
Townsendia smithii	
Trifolium neurophyllum	
Verbena pinetorum	
Zigadenus virginatus	*Anticlea vaginata* Rydb. Consider under this name.

BOOK REVIEW *Douglas Ripley, President, Cochise Chapter, Arizona Native Plant Society*

Mountain Trees of Southern Arizona — A Field Guide

by Frank Rose. 2012. 104 pp. $19.95. Arizona-Sonora Desert Museum Press.

This beautiful and useful field guide to the mountain trees of Southern Arizona is a sequel to long-time Arizona Native Plant Society member Frank Rose's highly acclaimed *Mountain Wildflowers of Southern Arizona — A Field Guide to the Santa Catalina Mountains and Other Nearby Ranges*, published in 2011.



The geographical area of the guide includes the mountain areas of Southern Arizona south of the Mogollon Rim. Forty one of the most common native tree species to be encountered in those regions are represented. For each species an interesting description is provided, including information on the tree's physical characteristics, habitat, and distribution. But it is the author's superb photographs that make this field guide exceptional. A series of nine photographs accompany the discussion of each species which illustrate beautifully the overall habit of the tree and its individual characteristics such as its bark, leaves, reproductive structures, etc.

Also included is a distribution table of trees in selected ranges of Southern Arizona, a very informative etymology and miscellany of botanical names which I found most interesting, and a comprehensive glossary of botanical terms. The complete index of botanical and common names makes finding an individual tree in the text easy.

It would be hard to imagine a more useful or attractive field guide to the mountain trees of Southern Arizona for anyone interested in our native flora, regardless of their professional training, than this impressive book.

Appendix B. Rank Scores for *Very High Priority*, *High Priority*, and *Watch* Rank Categories

	NAME | COMMON NAME	Range	No. of Populations	Abundance	Habitat Specificity	Intrinsic Rarity	Threats	Population Trend	Rank Score	Potential Rank Score	Average Rank Score	Mexico Distribution	AZ Rare Plant Field Guide[1]
VERY HIGH PRIORITY	*Agave delamateri* W.C. Hodgson & L. Slauson | Tonto Basin Agave	2	0	1	1	1	1	1	7	7	7		c
	Agave phillipsiana W.C. Hodgson | Grand Canyon Century Plant	2	0	1	1	1	1	1	7	7	7		nc
	Anticlea vaginata Rydb. | Sheathed deathcamus	2	1	1	1	1	1	unk	7	8	7.5		nc
	Astragalus holmgreniorum Barneby | Holmgren (Paradox) Milk-vetch	2	1	1	1	1	1	0	7	7	7		c
	Chylismia exilis (P.H. Raven) W.L. Wagner & Hoch | Cottonwood Springs suncup	2	1	1	1	1	1	unk	7	8	7.5		c
	Eryngium sparganophyllum Hemsl. | Ribbonleaf Button Snakeroot	2	1	1	1	unk	unk	1	6	8	7	y?	nc
	Mentzelia memorabilis N.H. Holmgren & P.K. Holmgren | September 11 Stickleaf	2	1	1	1	1	1	0	7	8	7.5		nc
	Pediocactus bradyi L. Benson | Brady Pincushion Cactus	2	1	1	1	1	1	1	8	8	8		c
	Phacelia cronquistiana S.L. Welsh | Cronquist's Phacelia	2	1	1	1	1	1	unk	7	8	7.5		nc
	Salvia amissa Epling | Aravaipa Sage	2	1	1	1	1	unk	1	7	8	7.5		c
	Sphaeralcea gierischii N.D. Atwood & S.L. Welsh | Gierisch mallow	2	1	1	1	unk	1	1	7	8	7.5		nc
HIGH PRIORITY	*Actaea arizonica* (S. Watson) J. Compton | Arizona Bugbane	2	1	1	1	1	0	0	6	6	6		c
	Agave murpheyi F. Gibson | Hohokam Agave	1	0	1	1	1	1	1	6	6	6		c
	Agave yavapaiensis Hodgson & Saliwan | Yavapai Agave	2	1	1	1	1	0	unk	6	7	6		nc
	Aliciella cliffordii J.M. Porter	2	1	1	1	unk	0	unk	5	7	6		nc
	Amsonia kearneyana Woodson | Kearney's Blue-star	2	1	1	0	1	0	1	6	6	6		c
	Asclepias welshii N.H. Holmgren & P.K. Holmgren | Welsh's Milkweed	2	1	1	1	1	0	unk	6	7	6.5		c
	Astragalus ampullarius S. Watson | Gumbo Milk-vetch	1	1	1	1	1	1	unk	6	7	6.5		
	Astragalus beathii C.L. Porter | Beath Milk-vetch	2	1	1	1	unk	0	unk	5	7	6		c
	Astragalus sophoroides M.E. Jones | Tuba City Milk-vetch	2	1	1	1	unk	0	unk	5	7	6		c
	Carex specuicola J.T. Howell | Navajo Sedge	1	0	1	1	1	1	1	6	6	6		c
	Castilleja kaibabensis N.H. Holmgren | Kaibab Paintbrush	2	1	1	1	1	0	0	6	6	6		c
	Cirsium mohavense (Greene) Petr.	1	1	1	1	0	1	1	6	6	6		
	Cryptantha semiglabra Barneby | Smooth Catseye	2	1	1	1	1	0	0	6	6	6		nc
	Erigeron kuschei Eastw. | Chiricahua Fleabane	2	1	1	1	unk	0	unk	5	7	6		c
	Eriogonum mortonianum Reveal | Morton Wild-buckwheat	2	1	1	1	0	unk	unk	5	7	6		c
	Eriogonum ripleyi J.T. Howell | Ripley Wild-buckwheat	2	1	1	1	0	1	unk	6	7	6.5		c
	Eriogonum terrenatum Reveal | San Pedro Wild Buckwheat	2	1	1	1	1	0	0	6	6	6		nc
	Errazurizia rotundata (Wooton) Barneby | Roundleaf Errazurizia	2	1	1	1	unk	0	unk	5	7	6		c
	Escobaria robbinsiorum (W.H. Earle) D.R. Hunt | Cochise Pincushion Cactus	2	1	1	1	unk	0	unk	5	7	6		c
	Flaveria mcdougallii Theroux, Pinkava & Keil | Grand Canyon Flaveria	2	1	1	1	unk	0	1	6	7	6.5		c
	Muhlenbergia curtifolia Scribn.	2	0	1	1	unk	1	unk	5	7	6		nc
	Pediocactus paradinei B.W. Benson	2	1	1	1	unk	0	1	6	6	6		c
	Perityle ambrosiifolia Greene ex A. Powell & S.C. Yarborough | Ajo Rock Daisy	2	1	1	1	unk	0	Unk	5	7	6		nc
	Phacelia welshii N.D. Atwood | Welsh Phacelia	2	1	1	1	unk	0	unk	5	7	6		c
	Puccinellia parishii Hitchc. | Parish Alkali Grass	1	1	1	1	unk	1	unk	5	7	6		c
	Sclerocactus terrae-canyonae Heil | Longspine Fishhook Cactus	2	1	1	0	unk	1	unk	5	7	6		c
	Spiranthes delitescens Sheviak | Madrean Ladies'-tresses	2	1	1	1	0	unk	1	6	7	6.5	y	c

continued

[1]Arizona Rare Plant Field Guide Codes: (c=considered, nc=not considered, cr=considered rejected

Appendix B. Rank Scores for *Very High Priority*, *High Priority*, and *Watch* Rank Categories *continued*

	NAME | COMMON NAME	Range	No. of Populations	Abundance	Habitat Specificity	Intrinsic Rarity	Threats	Population Trend	Rank Score	Potential Rank Score	Average Rank Score	Mexico Distribution	AZ Rare Plant Field Guide[1]
HIGH PRIORITY	*Townsendia smithii* L.M. Shultz & A.H. Holmgren | Blackrock Ground Daisy	2	1	1	1	unk	0	unk	5	7	6		c
	Trifolium neurophyllum Greene | White Mountains Clover	2	1	1	1	unk	0	unk	5	7	6		c
WATCH	*Agave verdensis* Hodgson & Saliwan	2	0	1	1	1	0	unk	5	6	5.5		nc
	Berberis harrisoniana Kearney & Peebles | Kofa Mt Barberry	2	1	1	0	unk	0	unk	4	6	5		c
	Chylismia confertiflora (P.H. Raven) W.L. Wagner & Hoch | Grand Canyon Suncup	2	1	1	0	unk	0	unk	4	6	5		nc
	Cryptantha atwoodii Higgins | Atwood Catseye	2	1	0	1	unk	0	unk	4	6	5		nc
	Cylindropuntia abyssii (Hester) Beckeberg	2	1	1	1	0	0	0	5	5	5		nc
	Dalea tentaculoides Gentry | Gentry Indigo Bush	1	1	1	0	unk	1	unk	4	6	5	y	c
	Enceliopsis argophylla (D.C. Eaton) A. Nelson	2	1	1	1	unk	0	0	5	6	5.5		
	Eremothera gouldii (P.H. Raven) W.L. Wagner & Hoch | Gould Evening-primrose	1	1	1	1	0	1	unk	5	6	5.5		
	Erigeron heliographis G.L. Nesom | Pinalenos Fleabane	2	1	1	1	0	0	unk	5	6	5.5		c
	Erigeron lemmonii A. Gray | Lemmon Fleabane	2	1	1	1	0	0	unk	5	6	5.5		c
	Erigeron rhizomatus Cronquist | Zuni (Rhizome) Fleabane	2	0	1	1	unk	0	unk	4	6	5		c
	Erigeron sivinskii G.L. Nesom | Sivinski's Fleabane	2	1	1	1	0	0	unk	5	6	5.5		c
	Gentianella wislizeni (Engelm.) J.M. Gillett | Wislizeni Gentian	1	1	1	1	0	1	unk	5	6	5.5	y	nc
	Heterotheca rutteri (Rothr.) Shinners | Huachuca Golden Aster	2	1	1	0	unk	unk	0	4	6	5	y	nc
	*Hexalectris colemanii (*Catling) A.H. Kennedy | Chisos Coral-root	2	1	1	0	1	0	unk	5	6	5.5		nc
	Hieracium pringlei A. Gray | Pringle Hawkweed	2	1	1	0	0	unk	unk	4	6	5	y	c
	Lesquerella navajoensis O'Kane | Navajo bladderpod	1	1	1	1	unk	0	unk	4	6	5		c
	Mabrya acerifolia (Pennell) Elisens | Mapleleaf False Snapdragon	2	0	1	1	unk	0	unk	4	6	5		nc
	Macroptilium supinum (Wiggins & Rollins) A. Delgado & L. Torres	2	1	1	0	1	0	unk	5	6	5.5		nc
	Packera franciscana (Greene) W.A. Weber & A. Löve | San Francisco Peaks ragwort	2	1	1	1	unk	0	0	5	5	5		c
	Panicum mohavense Reeder | Mojave panicgrass	2	1	1	1		0	unk	5	6	5.5		c
	Pediomelum pauperintense S.L. Welsh, M. Licher & N.D. Atwood | Kane Breadroot	2	1	1	1	unk	0	0	5	6	5.5		nc
	Pediomelum pentaphyllum (L.) Rydb. | Poverty Mountain Breadroot	2	1	1	0	unk	1	unk	5	6	5.5		nc
	Penstemon distans N.H. Holmgren | Catalina Beardtongue	1	1	1	1	1	0	0	5	6	5.5		cr
	Perityle ajoensis T.K. Todsen | Sheep Range Beardtongue	2	1	1	0	0	unk	unk	4	6	5		c
	Phacelia buell-vivariensis N.D. Atwood | Buell Park phacelia	1	1	1	1	unk	0	unk	4	6	5		nc
	Phemeranthus marginatus (Greene) Kiger | Tepic Flame Flower	1	1	1	0	unk	unk	1	4	6	5	y	c
	Platanthera zothecina (L.C. Higgins & S.L. Welsh) Kartesz & Gandhi | Alcove Bog-orchid	1	0	1	1	1	1	unk	5	6	5.5	y	c
	Potentilla sanguinea Rydb. | Flagstaff Cinquefoil	2	1	1	0	unk	0	unk	4	6	5		nc
	Purshia x *subintegra* (Kearney) Henrickson (pro sp.) | Arizona cliffrose	2	1	1	1	0	0	0	5	5	5		c
	Salix arizonica Dorn | Arizona willow	1	1	1	1	0	1	unk	5	6	5.5		c
	Sclerocactus spinosior (Engelm.) Woodruff & L. Benson | Siler Fishhook Cactus	2	1	1	1	0	0	0	5	5	5		c
	Silene rectiramea B.L. Rob. | Grand Canyon Catchfly	1	1	1	1	unk	0	unk	4	6	5		nc
	Symphyotrichum welshii (Cronquist) G.L. Nesom | Welsh's American-aster	1	1	1	1	unk	0	unk	4	6	5		nc

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