

FLORA OF EL JARDÍN BOTÁNICO, EL CHARCO DEL INGENIO SAN MIGUEL
DE ALLENDE, GUANAJUATO, MEXICO

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ABSTRACT

The flora of El Jardín Botánico, El Charco de Ingenio (Guanajuato, México) is summarized. Analysis of the flora includes breakdowns by largest families, largest genera, growth form, and weedy tendencies. Brief descriptions are included of the various habitats available.

KEY WORDS: floristics, Guanajuato, México

INTRODUCTION

This study is a floristic inventory and analysis of selected aspects of the vegetation in El Jardín Botánico, El Charco del Ingenio (hereafter, "El Charco"), Cante, A.C., San Miguel de Allende, Guanajuato, México (hereafter, "San Miguel"), carried out between 1991 and 1993.

Within divisions (Lycopodiophyta, Polypodiophyta, and Magnoliophyta), plants are listed alphabetically by family, and, within families, alphabetically by genus and taxon. Family names are used according to the *International Code of Botanical Nomenclature* as reported in *Family Names in Current Use for Vascular Plants, Bryophytes, and Fungi* (Hoogland 1993).

Author citations follow the practice of *Flora Novo-Galiciana* (McVaugh 1992); but in all cases not covered by a volume in that series, recourse has been made to *Listado Florístico Preliminar del Estado de Querétaro* (Argüelles *et al.* 1991); except in the case of pteridophytes, when we follow the practice of *Listado Preliminar de Especies Pteridofitas de los Estados de Guanajuato, Michoacán, y Querétaro* (Díaz Barriga & Palacios-Rios 1992). In cases of conflicting usage, I have followed the advice of Dr. Jerzy Rzedowski.

The floristic inventory of 272 taxa of vascular plants is based on field surveys of the flora, and on collections made in 1991 and 1992 by Charles Glass, and in 1993 by Rocío Hernández and Walter L. Meagher. In most cases, determinations were made by Dr. J. Rzedowski. Mounted and labeled voucher specimens have been deposited with the Herbarium of Cante, A.C., Mesones 71, San Miguel de Allende, Guanajuato 37700, México.

SITE OF THE STUDY

El Charco is privately owned by the non-profit ecological organization, Cante, A.C. There are three divisions of the property. North of the Arroyo del Obraje is the Ecological Reserve, extending to 52 ha (128 acres). On this land -- high, exposed, and south-facing -- few collections were made, except near the rim of the canyon. The area within the fence on the south side of the Presa de Las Colonias, including the garden proper, an area in which cacti from other parts of México are being grown, is 12 ha (30 acres). West of the western gate is an area extending to 2.4 ha (5.9 acres). In addition, there is a narrow strip of land between the base of the canyon wall and the arroyo on its south side. The altitude of El Charco at the highest point on the *mesa* is 1,950 m; at the deepest point in the canyon, 1,895 m. Coordinates are Lat. 20° 51' and Long. 100° 49'.

VEGETATION IN OVERVIEW

Located within the Mesa Central, the more moist southern half of the Mexican Plateau, the vegetation of El Charco is principally savanna, that is, grasslands interspersed with low, often thorny trees in a semi-arid environment. The whole of El Charco, with the exception of the watery habitats and those associated with the shade of the canyon, conforms to the temperate vegetation type semi-arid grassland (short grass with scattered shrubs and cacti) as described by West & Augelli (1989).

In an area of El Charco extending along the shore of the presa and west to the principal pathway, the low thorny shrub *Mimosa aculeaticarpa* Ortega var. *biunifera* Ortega is dominant; in other grassy and shrubby areas, principally from the southernmost plantings of *Echinocactus grusonii* Hildm. north to the canyon rim and along its border, this shrub is infrequent to absent, and is replaced by the dominance in the understory of the non-native grass, *Rhynchelytrum repens* (Willd.) C.E. Hubb.

Asteraceae dominate the shrub story, high, medium, and low, in the area west of the western gate.

CLIMATE

The climate of San Miguel, without sudden changes in wind, cloud, temperature, or precipitation, is dry (Koeppen's BSh), with moderately hot, wet summers and fresh, warm, dry winters. In both winter and summer, the pattern of days is unvarying for long periods. From October, there is little or no precipitation until May. Cool evenings, cold nights, and cold early mornings are followed by warm and sunny days. With summer rains, a new pattern is established: days start with clear skies, then clouds gather, and showers fall by mid- to late afternoon. Daytime temperatures are cooler than in winter, and the mountain roads are impassable.

REGIONAL LANDFORMS

San Miguel, a landscape of sierras and mesas, belongs to a subprovince of The Central Plateau Morphotectonic Province (Ferrusquía-Villafranca 1993). The city and its environs lie on the northern margin of a larger region known as the Bajío. Characterized by wide flat basins, distant and occasional hills or solitary and long-degraded volcanic cones, isolated low mountains not rising much above 2,500 m h, the area is drained by the Río Lerma and its tributaries, of which the Río Laja, passing by San Miguel, is one. In central areas of the Bajío, there is deep dark soil supporting a rich and prosperous agriculture (Rzedowski 1987).

LOCAL LANDFORMS

Landforms in the vicinity of El Charco include the narrow valley of the Río Laja; crumpled piedmont rising westward from the river towards the Sierra de Guanajuato; and most prominently the Los Picachos Mountains, an ancient volcanic formation, rising to 750 m above El Charco; a rim of low-elevation rhyolitic mesas with which El Charco is identical in form and continues north from it, and on which the Ecological Reserve is sited; and old lake beds east of El Charco with drainage into the Presa de las Colonias along the southern shore, where much of the inner space of the gardens is situated.

GEOLOGY

The mesa upon which El Charco is sited is formed of hard rock of volcanic origin, principally andesite and rhyolite, with outcrops of breccia. Successive eruptions (in the mid-Tertiary Period, about 35 million years BP) over long periods of time, constructed the mesa and adjoining canyon. Visible material forming the canyon, is estimated to be 50 m deep at the maximum. The canyon, less than 1 km long and approximately 50 m deep at the mouth, is widest at the mouth, then narrows markedly for most of its course. It makes abrupt turns before ending at its most shallow point, just east of the pool for which it has been named. While most rock in El Charco is igneous, there is a narrow corridor near the canyon edge on the south side where kaolin has coated breccia, evidence of hydrothermal activity having occurred later than the volcanic and tectonic forces that largely shaped the landscape. Breccia outcrops at sites above and to the east of the appearance of the seam of kaolin are sparsely vegetated, but among the successful colonizers in this region is *Selaginella lepidophylla* Spring.

SOILS

Soils on the mesa of El Charco are thin and rocky. The rocks are hard and slow to decompose to their mineral elements. Patches of humus build up in protected sites at the base of thorny shrubs and trees, in the coves of rocks at the rim of the canyon, in

cracks and fissures in large boulders, and in the watery habitats associated with the flowing muds of the arroyo.

WOODY TAXA

A total of 82 taxa of woody plants, from low shrubs to tall trees, were recorded in El Charco, over the period September 1991 to December 1993. Of these, ten are arborescent cacti, and three are shrubby representatives from the same family. Of the rest, nine are trees and five are treelets; 68 are shrubs (including tall, medium, and low), 21 of which are members of the Asteraceae.

Rankings, based on field notes, are as follows. CACTI: (1) **arborescent** (taller than 3 m); (2) **shrubby** (from 1-3 m tall). TREES: (1) **very tall** (taller than 6 m); (2) **medium tall** (3-6 m tall). TREELETS: (taller than 2 m). SHRUBS: (1) **tall** (taller than 2 m); (2) **medium** (1-2 m tall); (3) **low** (0.5-1.0 m tall).

CACTI

The aim of this section is to rank woody taxa by size in order to display the stratification of vascular plants in the upper stories of the vegetation of El Charco. Cacti, therefore, are included (Gibson & Nobel 1986), but excluded are *Ferocactus*, *Mammillaria*, and *Stenocactus*.

Of the arborescent cacti, *Myrtillocactus geometrizans* (Mart.) Cons. is the most abundant, not on the overgrazed grasslands, but on the slopes, falling away from the mesa, facing south, north, and west. It is also found on the rim of the canyon, on canyon ledges, in matorral, and by the edge of the presa. Its abundance and distinctive form make it an attractive and emblematic feature of the landscape. Of other tall cacti, two are present in El Charco, but are rare: *Nyctocereus serpentinus* (Lag. & Rodr.) Britt. & Rose and *Stenocereus dumortieri* (Scheidw.) Buxb.

Arborescent opuntias include *Opuntia durangensis* Britt. & Rose, *O. fuliginosa* Griff., *O. incarnadilla* Griff., *O. leucotricha* DC., *O. pachona* Griff., *O. streptacantha* Lem., and *O. tomentosa* Salm-Dyck. More common than the arborescent taxa are the shrubby species: *O. inbricata* (Haw.) DC. and *O. robusta* Wendl. var. *robusta*. *Opuntia inbricata* is dominant in certain localities. Less common is *O. stenopetalata* Engelm.

TREES

The tall trees, in particular those taller than 10 m in height, are rare, and occur singly, mostly along the arroyo and in the shadiest parts of the canyon. The tallest is *Salix bonplandiana* H.B.K. Less tall trees include mesquite, armed huizaches, and cacti both arborescent and shrubby. These are plentiful, and form the most noticeable component of the vegetation of El Charco. *Schinus molle* L., which grows in wet as well as dry sites, achieves a height second to *Salix bonplandiana*.

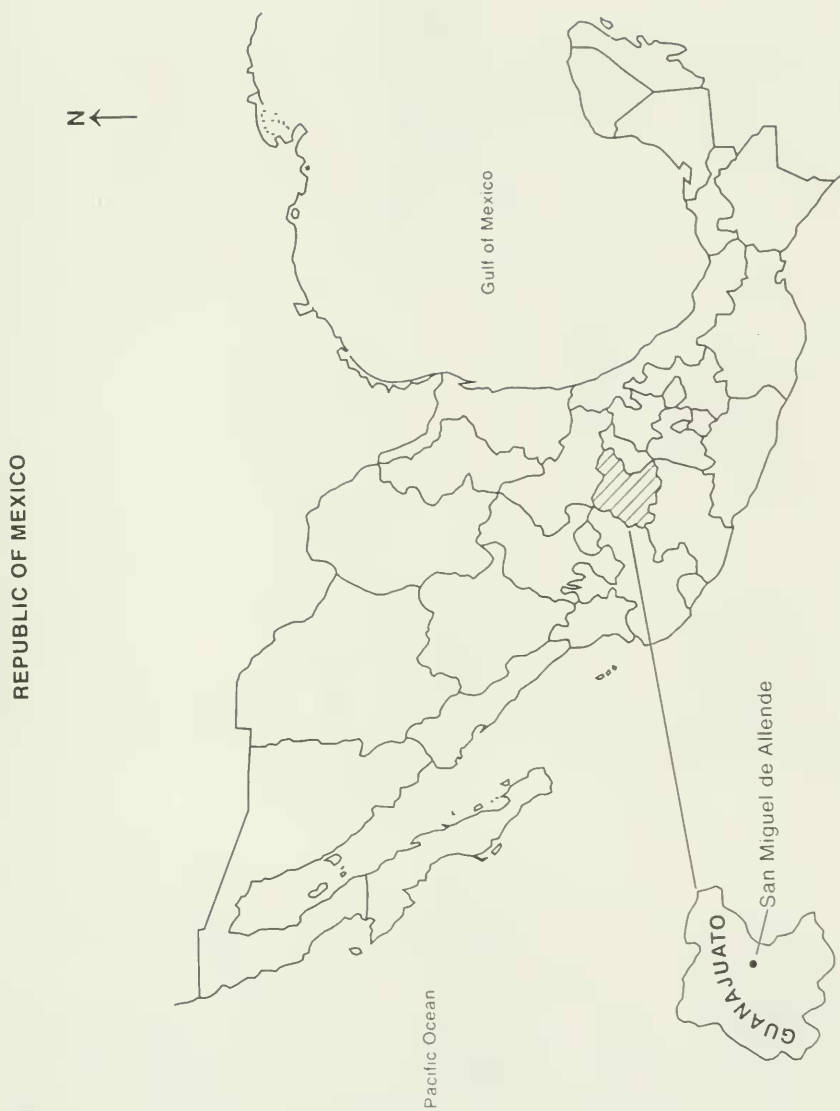


Figure 1. Map showing the location of San Miguel de Allende.

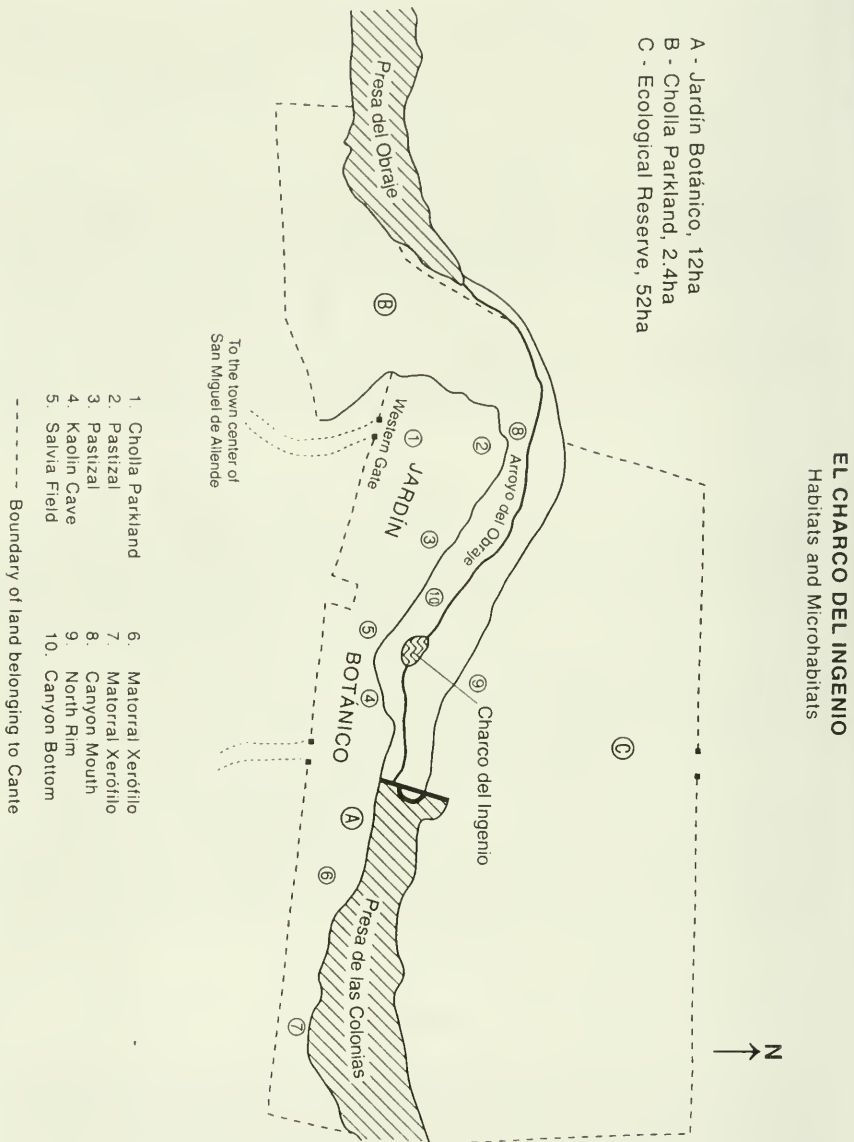


Figure 2. Map of Jardín Botánico, El Charco del Ingenio, showing the location of the principal habitats and microhabitats.

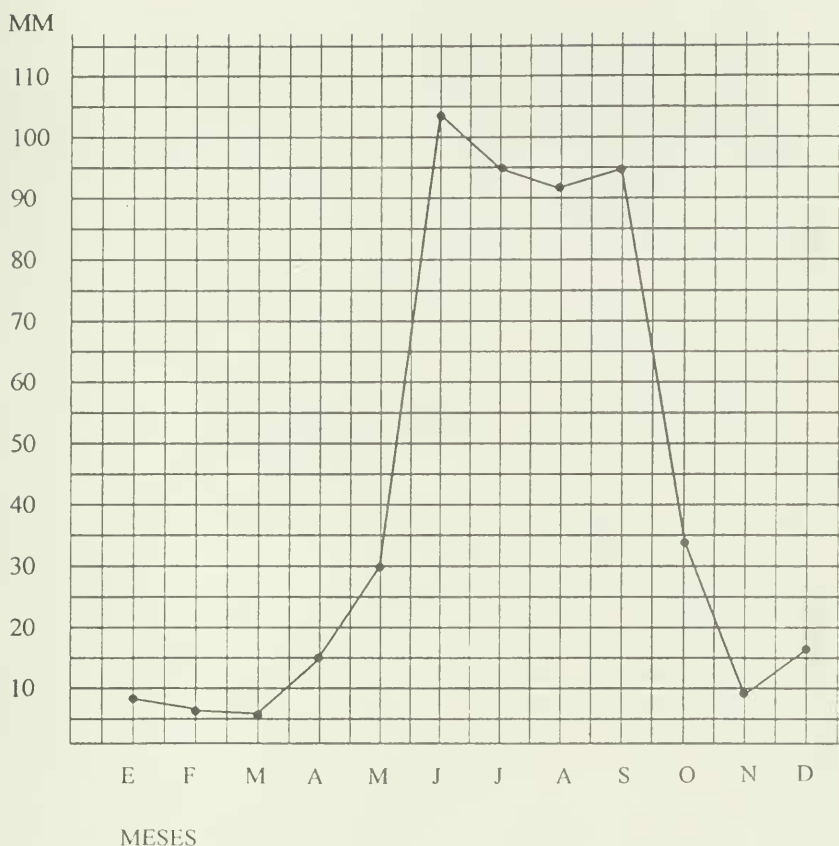


FIGURE 3: MAXIMUM AND MINIMUM TEMPERATURES

In this figure, average values for monthly maximum and minimum temperatures, reported from Estación San Miguel Allende, Number 93 at Long. $100^{\circ} 45' W$; Lat. $20^{\circ} 55' N$, and Alt. 1,950 m, are plotted. In the topmost line of the graph, the highest maximum temperature, reached in May, is only $7.3^{\circ} C$ greater than the highest minimum temperature, reached in June, shown in the line beneath. In the coldest months, the average minimum temperature is just above $8^{\circ} C$. While there is more wind, fog, dew, and colder temperatures in El Charco, which lies above the station from which these data have been reported, no one of these factors is limiting of plant growth independently of the long dry period of winter and the general scarcity of water in the matorral xerófilo.

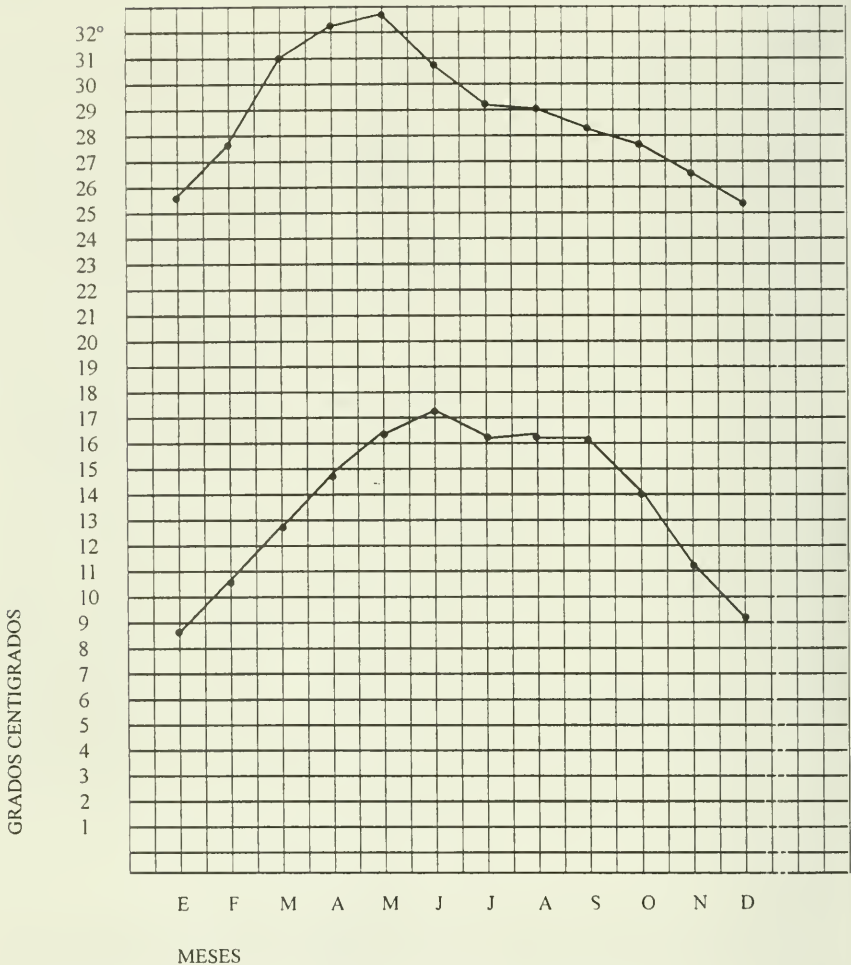
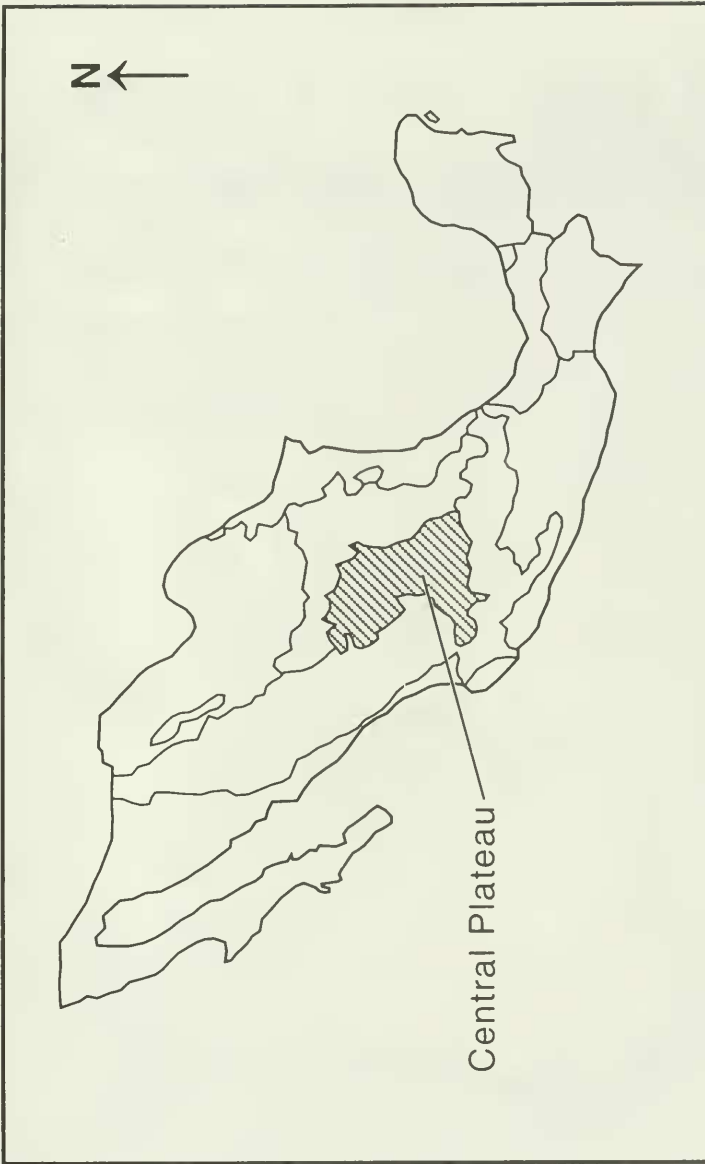


FIGURE 4: MAXIMUM AND MINIMUM PRECIPITATION

Average annual precipitation, as reported from Estación San Miguel Allende, is 512 mm. Average annual monthly distribution of precipitation, based on data collected from 1976 to 1986, is plotted on this figure. It would be interesting to plot the phenology of the principal woody species of El Charco; many species flower in early- to mid-April, just before the steepest rise in precipitation, which then occurs when fruit is setting. While moisture deficiency is the principal characteristic of the Mexican dry climates, nevertheless, the semi-arid zone receives twice the rainfall of the desert, a factor surely accounting for the high count in this inventory of herbaceous flora including herbaceous ephemerals.



MORPHOTECTONIC PROVINCES OF MEXICO

Figure 5. Map of the morphotectonic provinces of México.

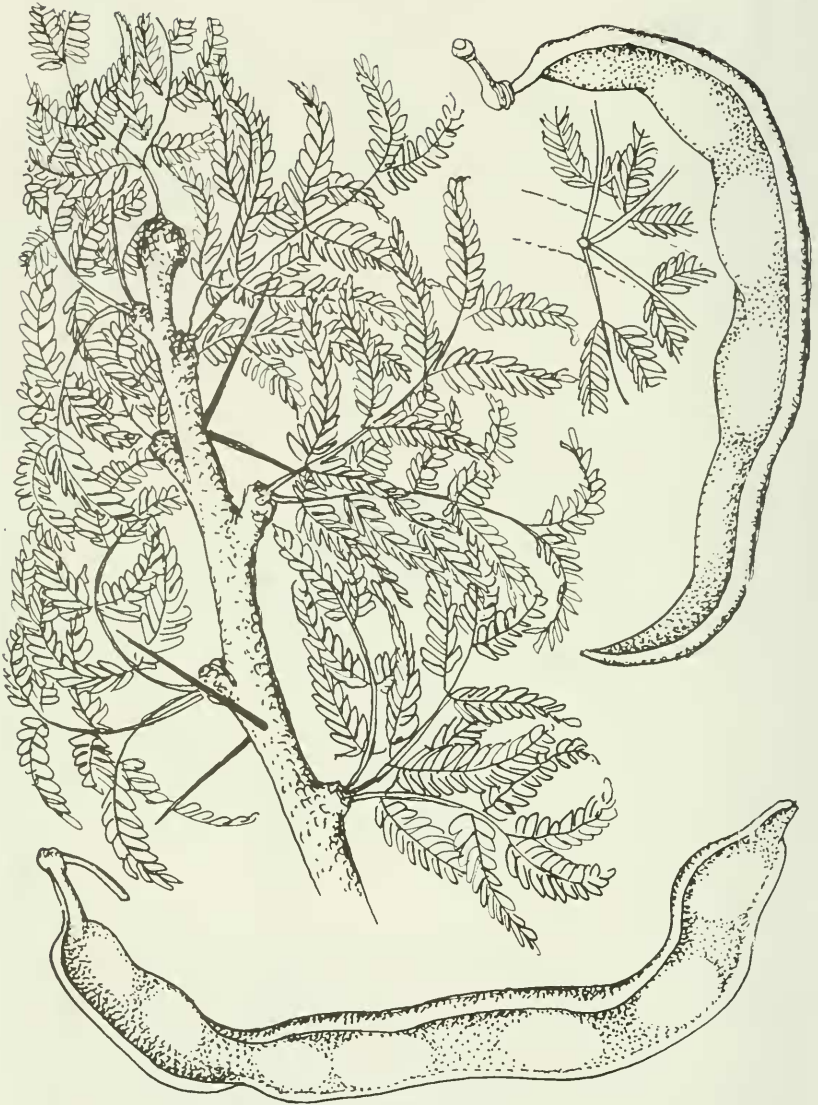


Figure 6. Drawing of *Acacia schaffneri*.

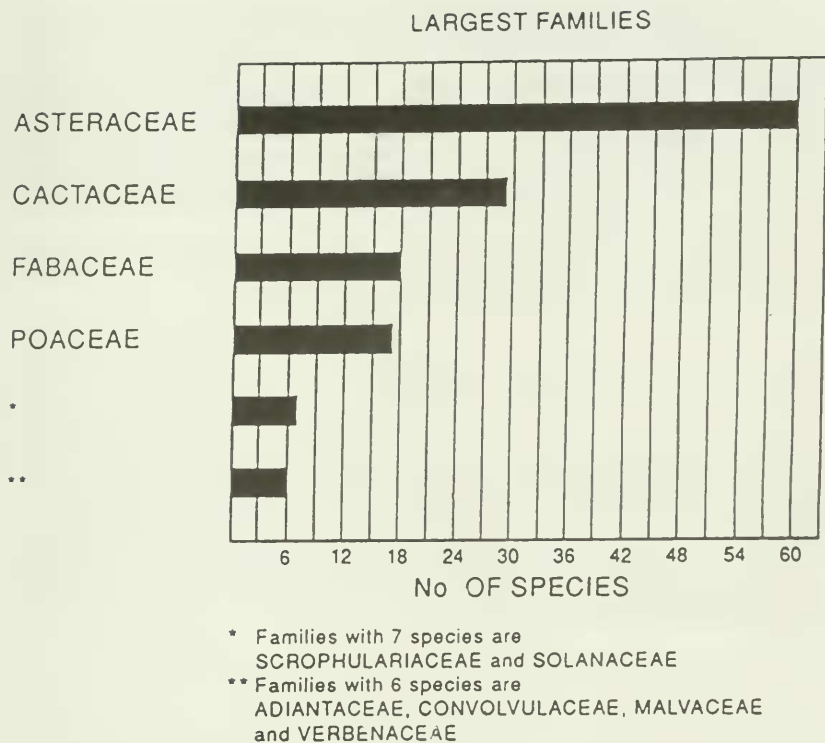


Figure 7. Graphical representation of number of species in families with greatest representation at El Charco.

Of the medium tall trees (taller than 3 m), three members of the Fabaceae are widely distributed in the dry grassy landscape - *Prosopis laevigata* (Willd.) M.C. Johnst., which in El Charco rarely is taller than 4 m, *Acacia farnesiana* (L.) Willd., and *A. schaffneri* (S. Wats.) F.J. Hermann. Less frequent in dry open places, but nevertheless represented in almost every habitat of El Charco, is the unarmed *Schinus molle*. For the rest, members of this category are represented by taxa much less numerous, in a few cases by only one or two trees, *Morus celtidifolia* H.B.K., *Fraxinus uhdei* (Wenzig) Lingelsheim, and *Carya illinoensis* (Wangenl.) K. Koch, or, at best, a few trees, *Phoebe arsenei* C.K. Allen, *Salix bonplandiana*, all characteristically sited in partial or deep shade.

One specimen of *Erythrina coralloides* Moç. & Sessé, with nine 4 m high trunks arising from one base, was located on the east-facing side of a large outcrop of rock on the northern slope of the canyon, outside the area of our survey.

TREELETS

Bursera fagaroides (H.B.K.) Engl. var. *fagaroides* is the most abundant of the treelets. It rarely exceeds 2 m h, is not common on the mesa, but stands in coves of vegetation just below the rim or just at the rim of the canyon, facing north; but on the northern slope of the canyon, facing south, *Bursera fagaroides* var. *fagaroides* is abundant if not dominant, reaching greater heights than on the south side. Other treelet taxa are very infrequent in El Charco, but abundant in other localities: *Eysenhardtia polystachya* (Ortega) Sarg., *Nicotiana glauca* Graham, *Ptelea trifoliata* L., and *Senna polyantha* (Colladon) Irwin & Barneby.

SHRUBS

Tall shrubs attain heights often greater than 2 m. Some, such as *Montanoa tomentosa* Cerv., reach 2 m in most of its sites. Most abundant of the tall shrubs are *Baccharis salicifolia* (Ruiz & Pavón) Pers., *Buddleia cordata* H.B.K., *Forestiera durangensis* Standl., and *Montanoa tomentosa*. Less common are *Bouvardia tenifolia* (Cav.) Schult., *Brickellia secundiflora* (Lag.) A. Gray, *Calliandra grandiflora* (L'Hér.) Benth., *Citharexylum lycioides* D. Don, *Eupatorium* sp., and *Iresine cassiniifolmis* Schau.

Shrubs of medium height, 1-2 m, make up the most taxon-rich category of woody taxa in El Charco. Field observations have not been made for *Baccharis multiflora* H.B.K., *Bouvardia multiflora* (Cav.) Schult., and *Eupatorium collinum* DC. Most abundant in this category, in the matorral xerófilo, is *Mimosa aculeaticarpa* var. *biuncifera*. In the same habitat, and elsewhere, *Acacia farnesiana* occurs as a shrub, and is common, as are *Ageratum corymbosum* Zuccagni, *Dalea bicolor* H. & B. ex Willd., *Desmodium* sp., *Loeselia mexicana* (Lam.) Brand, *Stevia serrata* Cav. var. *serrata*, *Trixis mexicana* Lex., *Verbesina serrata* Cav., and *Zaluzania augusta* (Lag.) Sch.-Bip. Less frequent are *Abutilon simulans* Rose, *Anisacanthus quadrifidus* (Vahl) Standl., *Croton adspersus* Benth., *Eupatorium pycnocephalum* Less., *Lantana canara* L., *Mimosa monancistra* Benth., *Montanoa leucantha* (Lag.) S.F. Blake var.

arborescens, *Pisoniella arborescens* (Lag. & Rodr.) Standl., *Ricinus communis* L., *Tecoma stans* (L.) H.B.K., and *Trixis mexicana* var. *auriculata* C. Anderson.

Of shrubs commonly as low as 10-15 cm, but rising to 1 m, there occur both a taxon more abundant than any other shrubby plant in El Charco, *Jatropha dioica* Sessé ex Cerv., and one more rare, *Eutretas pringlei* Greenm. Common on open ground, and enduring both sun and goats are *Asclepias linaria* Cav. and *Piqueria trinervia* Cav. Other taxa common in this class include *Brickellia veronicifolia* (H.B.K.) A. Gray, *Castilleja tenuiflora* Benth., and *Dalea lutea* (Cav.) Willd. Localized in their occurrence, like *Eutretas pringlei*, are *Eupatorium espinosarum* A. Gray and *Prunus microphylla* (H.B.K.) Hemsl.

HABITATS AND MICROHABITATS

Habitats mainly semi-arid include matorral xerófilo and grassland. Of each of these there are mixed versions, for instance, grassy hillslopes with (mainly) unarmed shrubs, and, on the other hand, grassy areas dotted with armed woody leguminous species.

Microhabitats, sites of topographical features different from the more widespread areas of habitat, include canyon rims, cave faces, spaces beneath the rims from which boulders have fallen away (coves), and canyon walls with their fissures and ledges.

In striking contrast are wet places, including ephemeral pools, areas of seepage from below the dam, muds of the arroyo bank from below the dam, floodplain terraces, and the wet margin of land touching the waters of the presa.

Shade is another element enhancing the diversity of habitats. There are portions of the north-facing side of the canyon where, in the late autumn and winter months, the sun never penetrates.

In the following sections, these habitats are considered: (1) matorral xerófilo, (2) *Salvia* field, (3) kaolin cave, (4) cholla parkland, (5) pastizal, (6) canyon microhabitats, and (7) wet places. Three of these sites, 3, 6, and 7, are much smaller than the others. For the rest, matorral xerófilo is 4.5 ha, *Salvia* field, plus pastizal, is 4.5 ha, and cholla parkland is 1.24 ha.

MATORRAL XEROFILO

In El Charco, matorral xerófilo is a mixture of grasses, short trees, cacti, and shrubs. It has two forms: one is degraded, the other is renascent. In the degraded form, which is prevalent outside of the fenced area to the south and west, the land has long fed cattle and goats, and the herbage is tightly grazed. The shrub form of *Acacia farnesiana* is more common than the tree form. The land has an aspect of paucity, if not poverty. But within the fenced part of El Charco, there is a portion of land protected from grazing, sloping from the east-west path to the edge of the waters of the presa, that is an example of the tendency of matorral xerófilo to become "dense, impenetrable thicket composed of stiff or thorny shrubs or dwarf trees," when ungrazed (Tomaselli 1992). Here, what strikes the eye is not the height of the woody taxa, but the density of the vegetation in the story of 1-2 m h.

Mimosa aculeaticarpa var. *biuncifera* is dominant in the low-medium shrub story, with heights commonly ranging between 65 and 85 cm. Taller than the average

Mimosa aculeaticarpa var. *biuncifera*, by at least 0.5 m, and ranging to over 2 m h, are *Citharexylum lycioides*, *Dalea bicolor*, *Desmodium* sp., *Forestiera durangensis*, *Opuntia imbricata*, juvenile *Prosopis laevigata*, and *Zaluzania augusta*. At about the same height as *Mimosa aculeaticarpa* var. *biuncifera* are: *Brickellia veronicifolia*, *Jatropha dioica*, and *Sphaeralcea angustifolia* (Cav.) G. Don. Marking the summit of vegetation in the matorral, at 3-4 m h, are: *Acacia farnesiana*, *A. schaffneri*, *Myrtillocactus geometrizans*, *Prosopis laevigata*, and, by the water's edge, *Schinus molle*. These are the woody taxa characteristic of most places in El Charco.

In the herbaceous strata, *Rhynchelytrum repens*, a non-native grass, is dominant. Locally plentiful, in openings among the shrubs, and often sheltered at their base, are: *Amaranthus hybridus* L., *Gomphrena decumbens* Jacq., *Ipomoea longifolia* Benth., *I. pubescens* Lam., *Mentzelia hispida* Willd., *Sanvitalia procumbens* Lam., *Tagetes lunulata* Ortega, and *Zinnia peruviana* (L.) L. Less commonly occurring are: *Bouvardia* sp., *Drymaria xerophylla* A. Gray, *Euphorbia* sp., *Lamou-ouxia rhinanthifolia* H.B.K., *Oxalis* sp., *O. corniculata* L., *Salvia hirsuta* Jacq., and *Solanum* sp.

The matorral xerófilo is open to herbivory by the velador's horse. Well-worn paths press through the thicket, which in many places is no longer impenetrable. Vegetation to the east, towards the site of the conservatory, is not a thicket so much as an untended pasture. Grass is plentiful; tall shrubs are scarce; the distance between taxa of 1.0-1.5 m h is greater; and *Mimosa aculeaticarpa* var. *biuncifera* is no longer dominant. Proportionately, there are more individuals of *Acacia schaffneri* and of *Desmodium* sp. There is a large patch of the small shrub (0.5 m h), *Prunus microphylla*. Isolated patches of the suffrutescent taxa - *Asclepias linaria* and *Piqueria trinervia* are common. Herbaceous plants are less plentiful; those that are found usually are in the shade of a bush, such as *Drymaria xerophylla*, *Heterosperma pinnatum* Cav., *Oxalis corniculata*, *Salvia hirsuta*, *Stevia micrantha* Lag., and *Verbena carolina* L.

SALVIA FIELD

"Salvia Field" is the steepest slope of land above the canyon rim, a grassy field in which unarmed shrubs are dominant. Familiar cacti include: *Myrtillocactus geometrizans*, *Opuntia imbricata*, and *O. robusta*; but these are few. In the story of tall bushes, there are a few *Forestiera durangensis*, but the principal shrubs, all of medium height, are *Brickellia veronicifolia*, *Castilleja tenuiflora*, *Dalea bicolor*, *Loeselia mexicana*, *Salvia polystachya* Ortega (very abundant), and *Stevia serrata*. When these taxa are in bloom, which they are all together in early autumn, the color is glorious. By November, *Salvia* and *Stevia* are gone. *Zaluzania augusta* is infrequent in this site, but walking east into an area of greater shade, there is an explosion of taller shrubs, reaching 2 m, mostly *Z. augusta* and *Montanoa tomentosa*. Below the shrub story, grasses dominate the hillslope. At the level of procumbent species, *Dichondra argentea* H. & B. is plentiful. With such abundance of *Salvia* in this stand, one is reminded that there may be as many as 300 species in the genus *Salvia* in México, a diversity greater than that for any other genus in the nation (Ramamoorthy & Elliott 1993).

KAOLIN CAVE

Along the path rimming the canyon just above the pool - El Charco - that once must have been a precious resource to Otomi inhabitants of the region, is a site of soft weathered whitened stone, undercutting the volcanic breccia above. The white material is kaolinite, a derivative of limestone, formed by hydrothermic activity, and coating the much harder volcanic rock.

Plants at this site (23 m long \times 5 m wide) are neither endemics nor calciphytes, and are found in other parts of El Charco. Many are weedy. *Buddleia cordata* is successful here as well as in the canyon below. Species collected: *Abutilon simulans* ("planta escasa y vulnerable a la extinción en el área de esta Flora" [Fryxell 1993]), *Acalypha* sp., *Amaranthus hybridus*, *Aster* sp., *Baccharis salicifolia*, *Bidens* sp., *Bouchea prismatica* (L.) Kuntze, *Bromus* sp., *Buddleia cordata*, *Cardiospermum halicacabum* L., *Desmodium* sp., *Euphorbia heterophylla* L., *Florestina pedata* (Cav.) Cass., *Forestiera durangensis*, *Galium mexicanum* H.B.K., *Gnaphalium* sp., *Ipomoea pubescens*, *Lantana camara*, *Loeselia mexicana*, *Mentzelia hispida*, *Montanoa tomentosa*, *Oxalis corniculata*, *Rhynchelytrum repens*, *Salvia polystachya*, *Schinus molle*, *Setaria geniculata* (Lam.) Beauv., *Solanum nigrescens* Mart. & Gal., *Sphaeralcea angustifolia*, *Taraxacum officinale* Wiggers, *Tetranerium nervosum* Nees, *Tillandsia recurvata* (L.) L., *Viguiera linearis* (Cav.) Hemsl., *Zaluzania augusta*, and *Zinnia peruviana*.

CHOLLA PARKLAND

Opuntia imbricata, conspicuously colonial in occurrence in arid lands, is no less so in El Charco, where it dominates the tall shrub story of the landscape outside the western gates of El Jardín Botánico to the eastern edge of the mesa. The common name of *Opuntia imbricata* in the Mesa Central is cardón, but in many parts of the Chihuahuan Desert region it is known as cholla.

In one 10 \times 10 m area, a sample was made of the height of eight plants of *Opuntia imbricata*. They formed two classes: (1) **Tall**: 52 cm, 55 cm, 34 cm, 84 cm, 70 cm, 55 cm, (2) **Medium**: 15 cm, 15 cm. North of Plaza del Pirul, *Opuntia imbricata* maintains its dominance, but there is a greater proportion of taller individuals in the population sampled: (1) **Tall**: 95 cm, 115 cm, 140 cm, 145 cm, (2) **Medium**: 50 cm.

Acacia farnesiana, *Myrtillocactus geometrizans*, *Opuntia* subg. *Platyopuntia* spp. ("platyopuntias"), *Prosopis laevigata*, and *Schinus molle* all reach a greater height than *O. imbricata*, but none is so abundant. *Schinus molle* reaches the greatest height; but the tallest tree in El Charco is a willow growing along the arroyo in the depths of the canyon. *Myrtillocactus geometrizans*, while never so abundant as *Opuntia imbricata* on the mesa, is much more abundant on the slopes that fall away from the mesa in three directions.

Sharing sub-dominance with *Opuntia imbricata* are: juvenile *Acacia farnesiana*, juvenile *Schinus molle*, and *Zaluzania augusta*. While conspicuous, "platyopuntias" are not so numerous as to be classified as sub-dominant. Nor is *Montanoa tomentosa*, which grows to 2 m, and is frequently associated with *Myrtillocactus geometrizans* on the western edge of the mesa.

Trees and shrubs in the landscapes of arid and semi-arid lands are often closely surrounded by a vegetation composed of small and medium-tall annuals, and

suffrutescent perennials (Magurran 1988). The armament of *Opuntia imbricata* as well as of other woody taxa has induced the establishment of island rings of vegetation. Defended against mammalian herbivory, these sites afford additionally a variety of benefits to the associated vegetation, including a portion of shade each day, the dripping of dew, other sources of extra moisture, soil enriched by inputs of organic matter, a safe lodgement for wind-blown seeds, and protected sites for seed germination.

Medium-tall shrubs *Ageratum corymbosum*, *Ambrosia cordifolia* (A. Gray) Payne, *Brickellia veronicifolia*, and *Viguiera linearis* are common throughout the area, and of these only *Ageratum* grows commonly within the protection of *Opuntia imbricata*. *Viguiera linearis* is most abundant in the section north of Plaza del Pirul, and is dominant in that story. Nearest neighbors in one plot of 11, *Viguiera linearis* had heights of 53, 75, 80, 83, 95, 105, 114, 60, 95, 60, and 33 cm. Generally shorter than medium-tall shrubs is *Jatropha dioica* dominant in its stratum. *Jatropha dioica* both nests with *Opuntia imbricata* and stands alone, becoming a site for development of vegetational islands. Composition of islands varies. *Prosopis laevigata* at 1.3 m h is associated with *Zaluzania augusta* at 1.5 m h. Nearby, *Opuntia robusta*, *Prosopis laevigata*, and *Zaluzania augusta* are joined in association. Throughout the area, *Acacia schaffneri* is the center of many island associations. Common beneficiary of all three preserves is *Rhynchelytrum repens*.

Tagetes lunulata and *Zinnia peruviana* compose a stratum intermediate between *Rhynchelytrum repens* and the lower levels of the herbaceous story. These taxa are plentiful and beautiful, growing in open spaces, on the edge of paths, and within the protection of shrub and tree islands.

Herbaceous taxa half the size of *Tagetes* and *Zinnia*, such as *Galinsoga parviflora* Cav. and *Verbena bipinnatifida* Nutt., are plants that rarely grow outside the vicinity of shrub and tree islands in the Cholla Parkland. One stand of *Opuntia imbricata* included the herbaceous plants: *Cuphea wrightii* A. Gray (12.5 cm), *Euphorbia dentata* Michx. (15.5 cm), *Galinsoga parviflora* (26 cm), *Heterosperma pinnatum* (16.5 cm), *Melampodium longifolium* B.L. Rob. (8 cm), *Sanvitalia procumbens* (4 cm), and *Tridax coronopifolia* (H.B.K.) Hemsl. (8.3 cm).

In the Cholla Parkland, *Gomphrena decumbens* and *Sanvitalia procumbens* occupy the trampled, grazed, dry, and open sunny spaces between *Opuntia imbricata*, as well as the roadway and its edges.

Distinctive of the northernmost part of this section of El Charco is the population of *Ferocactus latispinus* (Haw.) Britt. & Rose where in one portion of the area 5 × 5 m were counted 30 plants on 25 October 1993, of which 35% were then in flower. A portion of this site, including sixteen *Ferocactus latispinus* plants, was burnt by fire in the third week of December, 1993.

PASTIZAL

In land adjoining Cholla Parkland, facing north on slopes that rise to the main pathway through El Charco, the dominant taxon is *Rhynchelytrum repens*, which both by density of cover and coloration (loosely branched rosy-red panicles) characterizes this part of El Charco. This grass is in some spaces crowded with, and in others only dotted with, the woody taxa *Acacia farnesiana*, *Myrtillocactus geometrizans*, *Opuntia imbricata*, and *Schinus molle*; and in both these areas *Desmodium* sp., *Jatropha dioica*,

Loeselia mexicana, *Montanoa tomentosa*, and *Viguiera linearis* make up the shrub story.

THE CANYON

Habitat components of the canyon are: (1) the north-facing wall; (2) the rim of the canyon on the south side; (3) the canyon bottom shaded by the north-facing wall; (4) wet and sunny places along the arroyo-side at the mouth of the canyon; and (5) the south-facing aspect of the canyon rim on the north side.

The North-Facing Wall

The wall of the canyon is nearly vertical in most places, but plants take root wherever the solid wall is fractured in cracks and fissures, or where ledges have formed. Taxa on the canyon wall are of two kinds: (1) those that are common in other habitats in El Charco, and these include *Bouvardia ternifolia*, *Brickellia veronicifolia*, *Cheilanthes myriophylla* Desv., *Leonotis nepetifolia* (L.) Rich., *Montanoa tomentosa*, *Myrtillocactus geometrizans*, *Opuntia* sp., *O. imbricata*, *Rhynchelytrum repens*, *Schinus molle*, *Sedum ebracteatum* Moç. & Sessé, *Tagetes lunulata*, and *Tillandsia recurvata*; and (2) taxa restricted to sites on the canyon wall, including *Eutetras pringlei*, *Ferocactus histrix* (DC.) Linds., and *Phlebodium areolatum* (Willd.) J. Smith.

Canyon Rim (South Side)

Where boulders have fallen away from just below the summit of the canyon wall, coves have formed, affording added space for vegetation. Commonly abundant in these sites are *Ageratum corymbosum*, *Bouvardia ternifolia*, *Brickellia veronicifolia*, *Castilleja tenuiflora*, *Eupatorium espinosarum*, *Gnaphalium* sp., *Loeselia mexicana*, *Montanoa tomentosa*, *Stevia serrata* var. *serrata*, *Trixis mexicana* var. *mexicana*, and *T. mexicana* var. *auriculata*. Less common are *Bursera fagaroides* var. *fagaroides*, young *Myrtillocactus geometrizans*, and *Opuntia imbricata*.

Sparse elsewhere in El Charco, but characteristic of the rim on the south-side, is *Eupatorium espinosarum*. Wide flat rocks are exposed near the rim, providing surfaces for populations of lichens. These alternate in varying preponderances of species, from rock to rock. Typical are red-orange, chartreuse, and dull blue-green lichens. Facing north, below the lip of boulders off the Canyon Edge Walk, are *Dichondra argentea*, *Drymaria laxiflora* Benth., *Galium mexicanum*, and *Selaginella lepidophylla*.

Canyon Bottom

Shaded for nearly all hours of the day, but more in winter than in summer, the canyon bottom, between the south side of the arroyo and the canyon wall, is habitat for a variety of trees, tall and low shrubs, lianas, many of which cannot generally be seen outside this habitat, and low herbs. Trees: *Fraxinus uhdei*, *Morus celtidifolia*,

Phoebe arsenei, *Salix bonplandiana*, and *Schinus molle*; Shrubs: *Anisacanthus quadrifidus*, *Leonotis nepetifolia*, and *Trixis mexicana* var. *auriculata*; Lianas: *Parthenocissus quinquefolia* (L.) Planch., Tall Herbs: *Conyza sophiifolia* H.B.K., and *Pericalia sessilifolia* (Hook. & Arn.) Rydb., Low Herbs: *Piqueria trinervia*, *Stevia micrantha*, and *S. ovata* Willd.

Side of the Arroyo at the Mouth of the Canyon

This is a wet and sunny site. Abundant are: *Baccharis salicifolia*, *Cyperus virens* Michx., *Polygonum lapathifolium* L., *Schinus molle*, and *Toxicodendron radicans* (L.) Kuntze.

South-Facing Rim of the North Side of the Canyon

Brickellia secundiflora, *Dichondra argentea*, *Eupatorium pycnocephalum*, *Sedum* sp., *S. ebracteatum*, and, away from the rim and inland by some meters, *Verbesina sphaerocephala* A. Gray.

WET PLACES

Between the cortina and the largest pool in the canyon are a series of wet places, or water-modified environments, including: (1) areas of seepage below the cortina, (2) ephemeral pools, (3) moist muds, (4) a floodplain occurring in two tiers (A and B) above the muds, (5) crevices in rocks of the stream bed, and (6) an island 1.480 m long by widths varying as follows, at over 2 m intervals: 1.10 m, 1.70 m, 2.80 m, 1.10 m, 1.60 m, and 1.00 m.

Areas of Seepage

Seepage is greatest on the north side of the arroyo. *Mimulus glabratus* H.B.K. occurs there, and nowhere else in El Charco. Particularly abundant is *Cyperus niger* Ruiz & Pavón.

Ephemeral Pools

Gaura coccinea Pursh, *Ludwigia peploides* (H.B.K.) Raven (with the roots of these plants extending out of the water and over the bare and dry rocks adjoining the pools), *Marsilea mollis* B.L. Rob. & Fernald (also especially abundant late in the season all around the shore of the island), and *Peperonia campylotrapa* Hill are all common in the pools.

Moist Muds

Cyperus niger, *Eleocharis montevidensis* Britt., *Eriochloa acuminata* (Presl) Kunth, *Polygonum lapathifolium*, *P. mexicanum* Small, *Rumex crispus* L. *Schkuhria pinnata* (Lam.) Kuntze var. *virgata* (Lam.) Kuntze ex Thell., and *Tagetes lunulata* grow, often luxuriantly, in the muds.

Floodplain A

Species of the floodplain nearest the arroyo: *Melampodium glabrum* S. Wats., of which Dr. J. Rzedowski says, "It is practically endemic to the Bajío area" (Rzedowski & Rzedowski 1979, 1985), and *Melilotus officinalis* (L.) Pallas.

Floodplain B

Species of the floodplain farthest from the arroyo: *Acacia schaffneri*, *Anoda cristata* (L.) Schldl., *Cyclanthera dissecta* (Torrey & A. Gray) Arn., *Erodium cicutarium* (L.) L'Hér., *Euphorbia graminea* Jacq., *Euphorbia heterophylla*, *Psittacanthus calyculatus* DC., and *Schinus molle*.

Rock Crevices

Here one finds *Cyperus esculentus* L., *Ipomoea painteri* House, and *Toxicodendron radicans*.

Island Vegetation

This small island, 6 × 2 m, is densely covered in grass (and is tightly grazed by late autumn). In addition, there are *Baccharis salicifolia*, *Cyperus* sp., *C. virens*, *Eleocharis macrostachya* Britt., *Helenium mexicanum* H.B.K., *Melilotus officinalis*, and juvenile *Salix bonplandiana* (about 3 m h).

Lake-Side

Separate from the microhabitats described above is the edge of the presa extending from the cortina east to the limit of El Charco, within the fenced perimeter. Here the matorral xerófilo abuts on the world of water. Wet place species growing on the lake edge include *Baccharis salicifolia*, *Cyperus virens*, *Polygonum lapathifolium*, *P. mexicanum*; and in restricted sites: *Eleocharis macrostachya*, *Ludwigia peploides*, *Marsilea mollis*, and *Melampodium glabrum*.

ASPECTS OF DIVERSITY

DIVERSITY

While rarity is important, Magurran (1988) has shown that diversity is the most frequently adopted standard by which areas are judged. The data of this study, presented without comparison to species-richness or habitat diversity in similar sites elsewhere in the Mesa Central, may itself serve as a basis for future comparisons, including as a measure of change and stability in habitat and species diversity in El Charco.

Table 1. Summary of the Vascular Flora

	Family		Genera		Species	
Lycopodiophyta & Polypodiophyta	4	(5%)	5		10	
Dicotyledonae	50	(85%)	167	(96%)	241	(88%)
Monocotyledonae	5	(8%)	12	(7%)	21	(7%)
Total	59		184		272	

While pteridophytes are rare in grasslands, and thorn and desert scrubs in México (Riba 1993), they are well-represented (with three families and nine species) in the varied, but principally xeric, habitats of El Charco.

FAMILIES WITH THE GREATEST NUMBER OF SPECIES

The four richest families comprise 46% of all the species. Of these four, the numerical ascendancy of the Asteraceae, with 50% more species than the next richest family, is preponderant. With regard only to species-richness, El Charco is a landscape of Asteraceae in association with cacti, grass, and legumes.

For the rest, 27 families are represented by one species each. They are: Acanthaceae, Apocynaceae, Bignoniaceae, Buddleiaceae, Burseraceae, Campanulaceae, Capparaceae, Cucurbitaceae, Geraniaceae, Juglandaceae, Lauraceae, Loasaceae, Lorantheaceae, Malpighiaceae, Marsileaceae, Martyniaceae, Moraceae, Papaveraceae, Phytolaccaceae, Piperaceae, Polemoniaceae, Polyodiaceae, Rosaceae, Rutaceae, Salicaceae, Selaginellaceae, and Vitaceae.

Whereas Asteraceae is the most taxon-rich family, dominance in cover is achieved by Poaceae. There is no microhabitat in El Charco that does not find the presence of *Rhynchelytrum repens*, a non-native invasive grass, and no other species is so numerous. Quite rightly, one may call El Charco a grassland first and foremost, and

secondarily a vegetation of woody taxa in which Asteraceae, Cactaceae, and Fabaceae are co-dominant.

Table 2. Table of Some Biological Forms

WOODY PLANTS

	Number of Species
Arborescent cacti	21
Other cacti	8
Trees and treelets	15
Shrubs	43
Of all plants surveyed, % that are woody, including cacti	32
% excluding cacti	21

HERBACEOUS PLANTS

Herbaceous plants excluding succulents listed below	169
Of all plants surveyed, % that are herbaceous	62

SUCCULENT PLANTS

Cactaceae	29
Commelinaceae	3
Crassulaceae	4
Liliaceae (Agave only)	2
Portulacaceae	4
Of all plants surveyed, % that are succulent*	15

*Excluding plants that are fleshy without being resistant to long-term drought.

SPECIES-RICH GENERA

Of 184 genera of vascular plants represented in the survey, only eight genera have four or more species. *Opuntia*, the most species-rich genus, has seventeen; of the next richest, three genera *Cyperus*, *Cheilanthes*, and *Mammillaria* have six, six, and five species respectively.

Table 3. Species -rich genera at El Charco.

Genus	Species
<i>Cheilanthes</i>	6
<i>Eupatorium</i>	4
<i>Mammillaria</i>	5
<i>Opuntia</i>	17
<i>Drymaria</i>	4
<i>Cyperus</i>	6
<i>Euphorbia</i>	4
<i>Solanum</i>	4

Table 4. Sites of species-rich genera at El Charco.

Genus	Full Sun	Xeric Some Shade	Much Shade	Hydric
<i>Cheilanthes</i>	x	x	x	
<i>Eupatorium</i>		x	x	
<i>Mammillaria</i>	x			
<i>Opuntia</i>	x			
<i>Drymaria</i>	x		x	
<i>Cyperus</i> *				x
<i>Euphorbia</i>		x		
<i>Solanum</i>	x			

*This genus has one species in xeric sites; all others in hydric sites.

RARITY OF CACTI

In all strata, cacti are abundant, none more so than cespitose species. Of these, *Stenocactus* sp. are the most abundant; but in respect of species-richness, *Mammillaria* are more abundant in the strata of cespitose cacti than any other genus. But not all *Mammillaria* are equally abundant; indeed in El Charco more species are rare than common.

Table 5. Rarity of cacti in El Charco varied by genus.

Genus	Rare	Common
<i>Coryphantha</i>	+	
<i>Ferocactus</i>		+
<i>Mammillaria</i>		+
<i>Myrtillocactus</i>		+
<i>Nyctocereus</i>	+	
<i>Opuntia</i>		+
<i>Stenocereus</i>	+	
<i>Stenocactus</i>		+

Table 6. Rarity in the genus *Mammillaria* at El Charco.

Species	Rare	Common
<i>M. magnimamma</i>		+
<i>M. rettigiana</i>	++	
<i>M. uncinata</i>	++	
<i>M. wildii</i>	++	
<i>M. zephyranthoides</i>	++	

LOW AND PROSTRATE TAXA

Ground-hugging plants, least-tall of all strata of herbaceous plant life in El Charco, includes species prominent on grazed grassy sites, such as *Gomphrena decumbens*,

Ipomoea longifolia, and *Sanvitalia procumbens*; and species of wet sites, such as *Ludwigia peploides* and *Mimulus glabratus*. Common in open sites, at the margin of tree and shrub islands, and on edges of pathways, are *Bacopa procumbens* (Mill.) Greenm., *Dalea prostrata* Ortega, *Euphorbia indivisa* (Engelm.) Tidestr., *Guilleminea densa* (Willd.) Moq., *Pectis prostrata* Cav., and *Zornia thymifolia* H.B.K.

STATE RECORD

Based on *Listado Preliminar de Especies Pteridofitas de los Estados de Guanajuato, Michoacán, y Querétaro* (Díaz Barriga & Palacios-Rios 1992), the collection of *Phlebodium areolatum* in El Charco is a new state record.

Also new to the state of Guanajuato is *Sphaeralcea hastulata* A. Gray, a species which was not included in the fascicle on the Malvaceae family in the *Flora del Bajío y de Regiones Adyacentes* (Fryxell 1993).

TRIBES OF FABACEAE

Taxa of Fabaceae are well-represented in all strata of the vegetation of El Charco. Representation by tribes shows the dominance of Mimosoideae in the tree story and of Papilionoideae in the herbaceous layer.

Tribe	Genera	Species		
		tree	shrub	herb
Caesalpinioideae	1	1	0	0
Mimosoideae	4	4	3	0
Papilionoideae	7	1	3	8
Total	12	6	6	8

TRIBES OF ASTERACEAE

According to Turner & Nesom (1993), México, one of the centers of diversity for the family, is estimated to contain over 2,700 species of Asteraceae. Distribution of species among tribes in our survey supports the view that "the tribes Heliantheae and Eupatorieae are especially well developed in Mexico." Sixty-one species are distributed as follows:

TRIBE	Herbaceous	Woody
Astereae	5	3
Eupatorieae	2	9
Heliantheae	26	6
Inuleae	1	0
Lactuceae	2	0
Mutisieae	0	2
Senecioneae	1	0
Tageteae	4	0
TOTAL	41	20

WEEDY TAXA

In El Charco some 20% of the flora is weedy. Considering the use of the land, this proportion will increase. Favorable weed sites include new construction, pathways and their edges, plazas and their supporting walls, ditches, and fence rows.

Asteraceae have the highest representation of weedy taxa, including *Bidens odorata* Cav., *B. pilosa* L., *Conyza sophiifolia*, *Florestina pedata*, *Galinsoga parviflora*, *Heterosperma pinnatum*, *Machaeranthera pinnatifida* (Hook.) Shinnars, *Melampodium sericeum* Lag., *Parthenium bipinnatifidum* (Ortega) Rollins, *Pectis prostrata*, *Piqueria trinervia*, *Sanvitalia procumbens*, *Simsia amplexicaulis* (Cav.) Pers., *Sonchus oleraceus* L., *Tagetes lunulata*, *Tithonia tubiformis* (Jacq.) Cass., *Viguiera dentata* (Cav.) Spreng., *Xanthium strumarium* L., and *Zinnia peruviana*. Weedy Poaceae include *Brachiaria meziana* Hitchc., *Chloris virgata* Sw., *Echinochloa* sp., *Rhynchelytrum repens*, and *Setaria geniculata*.

Of the Brassicaceae, 100% of the species are weedy: *Eruca sativa* Miller, *Lepidium virginicum* L., and *Pennellia longifolia* (Benth.) Rollins. Of the Solanaceae: *Datura stramonium* L., *Nicotiana glauca*, *Solanum dulcamaroides* Dunal, *S. nigrescens*, and *S. elaeagnifolium* Cav. Six families are represented by two weedy taxa each: Amaranthaceae, with *Anaranthus hybridus* and *Gomphrena decumbens*; Euphorbiaceae, *Euphorbia indivisa* and *Ricinus communis*; Fabaceae, *Crotalaria pumila* Ortega and *Melilotus officinalis*; Malvaceae, *Sida abutilifolia* Mill. and *Sphaeralcea angustifolia*; Polygonaceae, *Polygonum lapathifolium* and *Rumex crispus*;

and Verbenaceae, *Bouchea prismatica* var. *brevirostra* Kuntze and *Verbena bipinnatifida*.

Five families (Convolvulaceae, Martyniaceae, Nyctaginaceae, Oxalidaceae, and Papaveraceae) contribute one species each: *Argemone ochroleuca* Sweet, *Evolvulus alsinoides* L., *Mirabilis nyctaginea* (Michx.) MacM., *Oxalis corniculata*, *Proboscidea louisianica* (Mill.) Thell. subsp. *fragrans* (Lindl.) Bretting.

Table 9. Weedy taxa found at El Charco.

Family	Number of herbaceous species	Number of woody species	Total herbaceous and woody species	% of family at El Charco	flora at El Charco
Asteraceae	14	5	19	31	7
Poaceae	6	0	6	35	2
Brassicaceae	3	0	3	100	1
Solanaceae	3	2	5	71	2
Fabaceae	2	0	2	11	0.007

CHECKLIST OF VASCULAR FLORA OF EL JARDIN BOTANICO, EL CHARCO
DEL INGENIO
DECEMBER 1993

LYCOPODIOPHYTA

SELAGINELLACEAE

Selaginella lepidophylla Sprng.

POLYPODIOPHYTA

ADIANTACEAE

Cheilanthes beitelii Mickel

Cheilanthes bonariensis (Willd.) Proctor

Cheilanthes incana (Presl) Mickel & Beitel

Cheilanthes lendigera (Cav.) Sw.

nc = not collected; nn = not native

ADIANTACEAE (cont.)

- Cheilanthes myriophylla* Desv.
Cheilanthes sinuata (Sw.) Domin
Pellaea ternifolia (Cav.) Link

MARSILEACEAE

- Marsilea mollis* B.L. Rob. & Fernald

POLYPODIACEAE

- Phlebodium areolatum* (Willd.) J. Smith

ANGIOSPERMAE

Dicotyledonae

ACANTHACEAE

- Anisacanthus quadrifidus* (Vahl) Standl.
Dicliptera peduncularis Nees
Dyschoriste sp.
Justicia furcata Jacq.
Tetramerium nervosum Nees

AMARANTHACEAE

- Amaranthus hybridus* L.
Gomphrena decumbens Jacq.
Guilleminea densa (Willd.) Moq.
Iresine cassiniaeformis Schau.

ANACARDIACEAE

- Schinus molle* L. nn
Toxicodendron radicans (L.) Kuntze nc

APOCYNACEAE

- Mandevilla foliosa* (Muell. Arg.) Hemsl.

ASCLEPIADACEAE

- Asclepias linaria* Cav.
Gonobolus uniflorus H.B.K.

ASTERACEAE

- Ageratum corymbosum* Zuccagni
Ambrosia cordifolia (A. Gray) Payne
Aster subulatus Michx.
Baccharis multiflora H.B.K.
Baccharis salicifolia (Ruiz & Pavón) Pers.
Bahia schaffneri S. Wats.
Bidens angustissima H.B.K.
Bidens ferulifolia (Jacq.) DC.
Bidens odorata Cav.

ASTERACEAE (cont.)

- Bidens pilosa* L.
Brickellia secundiflora (Lag.) A. Gray
Brickellia veronicifolia (H.B.K.) A. Gray
Conyza sophiifolia H.B.K.
Cosmos bipinnatus Cav.
Dyssodia papposa (Vent.) A.S. Hitchc.
Dyssodia porophylla (Cav.) Cav. var. *cancellata* (Cass.) Strother
Eupatorium collinum DC.
Eupatorium espinosarum A. Gray var. *espinosarum*
Eupatorium pycnocephalum Less.
Eupatorium sp.
Eutetras pringlei Greenm.
Florestina pedata (Cav.) Cass.
Galinsoga parviflora Cav.
Gnaphalium arizonicum A. Gray
Gymnosperma glutinosum (Spreng.) Less.
Helenium mexicanum H.B.K.
Heterosperma pinnatum Cav.
Heterotheca inuloides Cass.
Heliopsis annua Hemsl.
Machaeranthera gymnocephala (DC.) Shinnery
Machaeranthera pinnatifida (Hook.) Shinnery
Melampodium glabrum S. Wats.
Melampodium longifolium B.L. Rob.
Melampodium sericeum Lag.
Montanoa leucantha (Lag.) S.F. Blake subsp. *arborescens* (DC.) V.A. Funk
Montanoa tomentosa Cerv.
Parthenium bipinnatifidum (Ortega) Rollins
Pectis prostrata Cav.
Pericalia sessilifolia (Hook. & Arn.) Rydb.
Pinaropappus roseus (Less.) Less.
Piqueria trinervia Cav.
Sanvitalia procumbens Lam.
Schkuhria pinnata (Lam.) Kuntze var. *virgata* (Lam.) Kuntze ex Thell.
Simsia amplexicaulis (Cav.) Pers.
Sonchus oleraceus L.
Stevia micrantha Lag.
Stevia ovata Willd.
Stevia serrata Cav. var. *serrata*
Tagetes lunulata Ortega
Taraxacum officinale Wiggers
Tithonia tubiformis (Jacq.) Cass.
Tridax coronipifolia (H.B.K.) Hemsl.
Tridax palmeri A. Gray
Trixis mexicana Lex. var. *auriculata* C. Anderson
Trixis mexicana Lex. var. *mexicana*
Verbesina serrata Cav.
Verbesina sphaerocephala A. Gray var. *sphaerocephala*
Viguiera dentata (Cav.) Spreng. var. *canescens* (Cav.) Spreng.

ASTERACEAE (cont.)

- Viguiera linearis* (Cav.) Hemsl.
Xanthium strumarium L.
Zaluzania augusta (Lag.) Sch.-Bip.
Zinnia peruviana (L.) L.

BIGNONIACEAE

- Tecoma stans* (L.) H.B.K.

BRASSICACEAE

- Eruca sativa* Miller nn
Lepidium virginicum L.
Pennellia longifolia (Benth.) Rollins

BUDDLEIACEAE

- Buddleia cordata* H.B.K.

BURSERACEAE

- Bursera fagaroides* (H.B.K.) Engl. var. *fagaroides*

CACTACEAE

- Coryphantha elephantidens* Lem. nc
Echinocactus grusonii Hildm. nn
Ferocactus histrix (DC.) Linds. nc
Ferocactus latispinus (Haw.) Britt. & Rose nc
Mammillaria magnimanma Haworth. nc
Mammillaria retigiana Boedek nc
Mammillaria uncinata Zucc. nc
Mammillaria wildii Dietr. nc
Mammillaria zephyranthoides Scheidw. nc
Myrtillocactus geometrizans (Mart.) Cons. nc
Nyctocereus serpentinus (Lag. & Rodr.) Britt. & Rose nc
Opuntia amarilla Griff.
Opuntia cochinera Griff.
Opuntia durangensis Britt. & Rose
Opuntia fuliginosa Griff.
Opuntia hyptiacantha Weber
Opuntia imbricata (Haw.) DC.
Opuntia incarnadilla Griff.
Opuntia joconostle Weber
Opuntia lasiacantha Pfeiffer
Opuntia leucotricha DC.
Opuntia lindheimeri Engelm. var. *cuija* (Griff. & Hare) Benson
Opuntia matudae Scheinvar
Opuntia pachona Griff.
Opuntia robusta Wendl.
Opuntia stenopetala Engelm.
Opuntia streptacantha Lem.
Opuntia tomentosa Salm-Dyck
Stenocactus sp. nc
Stenocereus dumortieri (Scheidw.) Buxb. nc

CAMPANULACEAE

Lobelia fenestralis Cav.

CAPPARACEAE

Polanisia uniglandulosa (Cav.) DC.

CARYOPHYLLACEAE

Drymaria arenarioides Willd.

Drymaria laxiflora Benth.

Drymaria xerophylla A. Gray

Drymaria sp.

CONVOLVULACEAE

Dichondra argentea H. & B.

Evolvulus alsinoides L.

Ipomoea longifolia Benth.

Ipomoea painteri House

Ipomoea pubescens Lam.

Ipomoea purpurea (L.) Roth

CRASSULACEAE

Sedum ebracteatum Moç. & Sessé

Sedum sp.

Sedum sp.

Villadia parviflora Rose

CUCURBITACEAE

Cyclanthera dissecta (Torrey & A. Gray) Am.

EUPHORBIACEAE

Croton adspersus Benth.

Euphorbia dentata Michx.

Euphorbia graminea Jacq.

Euphorbia heterophylla L.

Euphorbia indivisa (Engelm.) Tidestr.

Euphorbia maculata L.

Jatropha dioica Sessé ex Cerv.

Ricinus communis L.

Tragia nepetifolia Cav.

FABACEAE

Acacia farnesiana (L.) Willd.

Acacia schaffneri (S. Wats) F.J. Hermann

Calliandra grandiflora (L'Hér.) Benth.

Crotalaria pumila Ortega

Dalea bicolor H. & B. ex Willd. var. *bicolor*

FABACEAE (cont.)

- Dalea lutea* (Cav.) Willd.
Dalea prostrata Ortega
Eysenhardtia polystachya (Ortega) Sarg.
Galactia brachystachys Benth.
Indigofera miniata Ortega
Macroptilium atropurpureum (DC.) Urb.
Macroptilium gibbosifolium (Ortega) A. Delgado
Melilotus officinalis (L.) Pallas nn
Mimosa aculeaticarpa Ortega var. *biuncifera* Ortega
Mimosa monancistra Benth.
Prosopis laevigata (Willd.) M.C. Johnst.
Senna polyantha (Colladon) Irwin & Barneby
Zornia thymifolia H.B.K.

GERANIACEAE

- Erodium cicutarium* (L.) L'Hér. nn

JUGLANDACEAE

- Carya illinoensis* (Wangenh.) K. Koch

LAMIACEAE

- Leonotis nepetifolia* (L.) Rich. nn
Salvia hirsuta Jacq.
Salvia nana H.B.K.
Salvia polystachya Ortega
Salvia reflexa Hornem.

LAURACEAE

- Phoebe arsenei* C.K. Allen

LOASACEAE

- Mentzelia hispida* Willd
Mentzelia hirsuta Willd.

LORANTHACEAE

- Psittacanthus calyculatus* DC.

LYTHRACEAE

- Cuphea wrightii* A. Gray
Heimia salicifolia (H.B.K.) Link

MALPIGHIACEAE

- Gaudichaudia cynanchoides* H.B.K.

MALVACEAE

- Abutilon simulans* Rose
Anoda cristata (L.) Schldl.
Malvastrum coromandelianum (L.) Garcke

MALVACEAE (cont.)

Sida abutilifolia Mill.*Sphaeralcea angustifolia* (Cav.) G. Don*Sphaeralcea hastulata* A. Gray

MARTYNIACEAE

Proboscidea louisianica (Mill.) Thell. spp. *fragrans* (Lindl.) Bretting

MORACEAE

Morus celtidifolia H.B.K.

NYCTAGINACEAE

Boerhavia coccinea Mill.*Mirabilis jalapa* L.*Mirabilis nyctaginea* (Michx.) MacM.*Pisoniella arborescens* (Lag. & Rodr.) Standl.

OLEACEAE

Forestiera durangensis Standl.*Fraxinus uhdei* (Wenzig) Lingelsheim

ONAGRACEAE

Gaura coccinea Pursh*Ludwigia peploides* (H.B.K.) Raven*Oenothera rosea* L'Hér.

OXALIDACEAE

Oxalis corniculata L.*Oxalis decaphylla* H.B.K.*Oxalis lunulata* Zucc.

PAPAVERACEAE

Argemone ochroleuca Sweet

PHYTOLACCACEAE

Phytolacca icosandra L.

PIPERACEAE

Peperomia campylotropa Hill

POLEMONIACEAE

Loeselia mexicana (Lam.) Brand

POLYGONACEAE

Polygonum lapathifolium L.*Polygonum mexicanum* Small*Rumex crispus* L. nn

PORTULACACEAE

Portulaca sp.*Talinopsis frutescens* A. Gray*Talinum napiforme* DC.*Talinum paniculatum* (Jacq.) Gaertn.

ROSACEAE

Prunus microphylla (H.B.K.) Hemsl.

RUBIACEAE

Borreria verticillata (L.) Meyer*Bouvardia multiflora* (Cav.) Schult.*Bouvardia ternifolia* (Cav.) Schult.*Galium mexicanum* H.B.K.

RUTACEAE

Ptelea trifoliata L.

SALICACEAE

Salix bonplandiana H.B.K.

SAPINDACEAE

Cardiospermum halicacabum L.

SCROPHULARIACEAE

Bacopa procumbens (Mill.) Greenm.*Castilleja tenuiflora* Benth.*Lamourouxia rhinanthifolia* H.B.K.*Maurandya barclaiana* Lindl.*Mimulus glabratus* H.B.K.

SOLANACEAE

Datura stramonium L.*Nicotiana glauca* Graham nn*Nicotiana tabacum* L. nn*Solanum dulcanaroides* Dunal*Solanum elaeagnifolium* Cav.*Solanum nigrescens* Mart. & Gal.*Solanum rostratum* Dunal

VERBENACEAE

Bouchea prismatica (L.) Kuntze var. *brevirostra* Kuntze*Citharexylum lycioides* D. Don*Lantana camara* L.*Phyla nodiflora* (L.) Greene*Priva grandiflora* (Ortega) Moldenke*Verbena bipinnatifida* Nutt.*Verbena carolina* L.

VITACEAE

Parthenocissus quinquefolia (L.) Planch.

Monocotyledonae

BROMELIACEAE

- Tillandsia recurvata* (L.) L.
Tillandsia usneoides (L.) L.

COMMELINACEAE

- Commelina dianthifolia* DC.
Commelina erecta L.
Thrysanthemum macrophyllum (Greenm.) Rohw.
Tradescantia crassifolia DC.

CYPERACEAE

- Cyperus calderoniae* S. González
Cyperus esculentus L.
Cyperus niger Ruiz & Pavón
Cyperus spectabilis Link
Cyperus virens Michx.
Cyperus sp.
Eleocharis macrostachya Britton
Eleocharis montevidensis Britton

IRIDACEAE

- Nemastylis tenuis* (Herb.) S. Wats.
Sisyrinchium tenuifolium H. & B.

LILIACEAE

- Agave filifera* Salm-Dyck
Agave sp.
Echeandia mexicana Cruden
Milla biflora Cav.
Zephyranthes sp.

POACEAE

- Andropogon* sp.
Andropogon sp.
Bambusa sp. nc
Bouteloua curtispindula (Michx.) Torrey
Bouteloua gracilis (H.B.K.) Lag.
Bouteloua repens (H.B.K.) Scrib. & Merr.
Brachiaria meziana Hitchc.
Bromus sp.
Chloris virgata Sw.
Echinochloa sp.
Eriochloa acuminata (Presl) Kunth
Heteropogon contortus (L.) Beauv. ex Roem. & Schult.
Muhlenbergia robusta (Fourm.) Hitchc.

POACEAE (cont.)

Rhynchelytrum repens (Willd.) C.E. Hubb. nn

Setaria geniculata (Lam.) Beauv.

Setaria grisebachii Fourn.

Tripsacum sp.

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